SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 15, 1901.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. McKeen Cattell, Garrison-on-Hudson, N. Y.

*PHYSICS AND FAITH.**

OUR knowledge concerning the properties of and changes in matter is gained in the first place through our bodily senses, and secondly through the intellect; the primary concepts thus acquired are confirmed, modified and enlarged by operations of the imagination and of the reason. The five senses with which we are endowed are of very unequal value in the acquisition of knowledge of natural objects; smelling, tasting and hearing make but small and unimportant contributions compared with those communicated by the senses of sight and of feeling.

An intelligent being, having only the single sense of feeling, would nevertheless be able to handle a large number of objects within his reach and to study their properties; he would early distinguish between matter at rest and matter in motion; he would notice the properties of inertia and of weight; he would perceive in his person the effects of heat and of cold, of dryness and of moisture; he would become acquainted with the shape of bodies of moderate size and with their superficial properties, such as smoothness or roughness, softness or hardness; he might, if he made sagacious use of his one power, recognize the distinction between matter in its three states—solid, liquid and

* Address of the retiring President of the Chemical Society of Washington, February 14, 1901.

gaseous, though it would be difficult for him to comprehend their relations to one another. Air in motion makes itself felt, but of gaseous matter in general his knowledge would be very limited and vague. The simplest of tests would make him acquainted with elasticity, malleability and ductility, as well as with density and tenacity; fusibility and solubility would undoubtedly greatly puzzle him, and he would of course remain ignorant of light, of sound and of the physical universe beyond his limited sphere.

If to this being of one sense the so-called 'chemical senses' of taste and of smell were added, he would acquire greater insight into the special qualities of bodies that affect these organs; he would observe the agreeable odors of the natural products of the soil and forest as well as the offensive ones in the three kingdoms of nature; he would learn to differentiate many gases previously regarded as identical; he would learn to distinguish between alkaline and acid, sweet and bitter substances, and to recognize those having particular flavors. On the other hand, the intelligent being of three senses would fail to comprehend the physiological processes by which the sensations are perceived, and in this respect he would be little less ignorant than are beings of five senses.

On endowing this imaginary person with the sense of hearing his knowledge of the external world would be greatly enlarged and his personal comfort increased, he would also acquire a more exact knowledge of some of the properties of matter; he would become conscious of vibrations in the air conveying sounds, and by listening to the roar of a Niagara or to the chirp of a cricket, to the melodies of song birds or to the fierce growl of a beast of prey, he would attain to more lofty ideas of the marvels of nature than in his deaf state. He could now learn of the crackling of brimstone, the 'cry' of tin, the snapping of electric sparks, and the startling detonations caused by combustion of 'villainous saltpetre' and of certain gaseous mixtures.

If finally, the precious gift of sight should be bestowed upon the subject of four senses a new world would be opened to him, and his intellectual and emotional capacities would be enhanced immeasurably; for the first time he would be able to realize the full meaning of the word beautiful as applied to nature. With the fifth sense he would perceive the beauty of form, of color, of luster, of ornamentation in the flower, the bird, the insect, the floating clouds and in the rainbow; he would have opened to him the magnificent spectacle of a starry firmament, of an aurora and of the sun in its noon-day glory. He would now be fairly equipped for investigating physical science.

At a remote period *seven* senses were attributed to man; these are given by the Hebrew author of the ancient book Ecclesiasticus as seeing, hearing, tasting, feeling, smelling, understanding and speech. They are referred to by the poet Pope in the couplet:

> "Good sense which only is the gift of Heaven,
> And though no science, fairly worth the seven,"

and the idea survives in the singular phrase in common use: 'Frightened out of one's seven senses.'

The nature of a sixth sense has been a matter of speculation, but it is hardly less difficult for individuals with five senses to form a conception of an extra sense, than it is for a sightless person to acquire any adequate idea of the true significance of seeing. The sixth sense has been called the muscular sense as distinguished from touch, but we prefer to think of it as a sense for cognizing forms of energy whose seat of action lies in the ether supposed to pervade space.

While it is absolutely impossible for a finite mind to plan the structure of an or-

gan that would give us this power or to conjecture its mode of action, in discussing it, we find it convenient to use terms analogous to those that we employ for the eye. We need, then, a keen sense that will enable us to 'see' what takes place in the interior of masses in their several states of aggregation; to 'see' the arrangement of the atoms within the molecule, and to study their behavior under the influence of well-known as well as obscure forms of energy. Even as Röntgen rays force a passage through the intermolecular voids of certain kinds of masses, a sixth sense might enable us to 'see' the action of heat in separating the molecules and the influence of chemism in uniting or in parting the atoms within them; to perceive the mechanism of solution, to 'see' the infinitesimal particles of sodium chlorid penetrate the aqueous liquid to form a homogeneous solution. To 'see' the exact manner in which an electrical 'current' (so-called) exerts its separating power when brought to bear upon a liquid; to test whether the theory of ionization has any substantial foundation. A sixth sense might permit us to 'see' the energy manifested by the Hertzian waves which under the skilful management of Marconi are just beginning to serve the interests of man; to learn the secrets of that medium permeating interstellar and intermolecular space which becomes the adjunct of sight; the art of photography has made visible views of the interior of masses impermeable to rays of light and has yielded permanent records of the sound waves of the air, but we seem to need a sixth sense to cognize the operations of the luminiferous ether.

In the fantastic conception in which we have indulged the imaginary being is supposed to be intelligent, for mere sense-perception without the cooperation of the intellect could not augment one's knowledge of the physical universe to any great extent. Through our bodily senses we learn the existence of natural phenomena, but it is through operations of the intellect that we acquire the deeper knowledge which becomes the subject of imagination, of reason and, eventually, of faith.

After observing that some kinds of matter suffer changes in form, in properties, in potential energy when subjected to the influence of heat, of light, as well as to the action of other kinds of matter, and that certain causes produce uniformly identical results, thinking men made endeavors to explain the phenomena by inventing hypotheses as to the essence of the material objects and of the various kinds of energy acting upon them. In the infancy of learning, Greek philosophers of wonderful intuition conceived a theory of the constitution of matter that has made a lasting impress on physical science; the theory possessed marvelous adaptability, and when a Manchester schoolmaster grafted upon the aged trunk the tender shoot of his genius, it soon grew to be a vigorous branch that bore fruit of unsuspected value. Nearly a century has elapsed and the atomic theory has secured a strong hold upon the minds of physicists and of chemists; maintained by men of sound judgment and great authority, imparted by teachers of recognized ability to successive generations of pupils, it has become a matter of belief, adopted with a few exceptions by scientists throughout the enlightened world, and in their hands it has become a potent factor in the progress of physical science. Yet this theory is purely a figment of the imagination and makes extraordinary assumptions difficult of credence; it supposes that matter is made up of very minute particles, indivisible, indestructible, and unchangeable, separated from one another by void spaces larger than the particles themselves; these diminutive atoms are of definite, uniform and constant figure, and are in perpetual motion in all

conceivable directions at exceedingly high rates of speed; moreover, the atoms composing the different chemical elements are of determinate weights corresponding to their equivalents of combination; these minute particles attract each other with varying degrees of strength and unite in simple ratios to form larger particles called molecules; agglomerations of these molecules constitute masses, visible to the eye and subject to the laws of mechanics.

Faith in this purely intellectual conception has enabled men of genius to refer to it the explanation of many facts, and the hypotheses resulting have developed into laws of prime importance in chemical philosophy; Dalton discovered facts in the union of chemical bodies whose interpretation he found in the doctrine of atoms; Humboldt and Gay-Lussac reinforced the Daltonian laws by their labors on the ratios in which the volumes of gases combine; Avogadro, by purely physical researches established the relation between the volumes of gases and the number of their constituent molecules; and Gerhardt, working in the field of organic chemistry, observed the bearing of these discoveries on chemical philosophy and, by clearly establishing the distinction between atom and molecule, gave to the atomic theory its modern aspects.

Faith in this theory has made it possible to devise a scheme of notation that in spite of its defects has proved of great utility in promoting the advancement of chemistry; the multitudinous problems of stoichiometry, the modern theories of solution and of electrolysis, the doctrines of isomerism and of stereo-chemistry are achievements of the intellect and of the reason based upon a belief in an imaginary condition of matter. To crown the whole, Newlands, the Englishman, originated, Meyer, the German, and Mendeléeff, the Russian, brought to a high state of perfection, the Periodic law which has given to chemistry that prophetic power, long regarded as the peculiar dignity of its sister science, astronomy.

Quite apart from these abstract principles, based upon a belief in the atomic constitution of matter, is the practical side of the question, of which the analytical chemist avails himself in determining the value of substances submitted to him; on the results of his figures thousands of dollars may change hands in the manufacturing, mining and commercial world. A ship-load of material is bought and sold on the result of the analysis of a sample conducted by a chemist, who bases his procedure on the supposed numerical relations of the invisible, intangible, immeasurable particles he calls atoms and in his calculations he relies on the constants determined by others, in whom he has confidence, and the accuracy of which constants he has to accept on faith. Reliance on the *dicta* and *data* of investigators whose very names may be unknown lies at the very foundation of physical science, and without this faith in authority the structure would fall to the ground; not the blind faith in authority of the unreasoning kind that prevailed in the middle ages, but a rational belief in the concurrent testimony of individuals who have recorded the results of their experiments and observations, and whose statements can be verified.

This faith in the fundamental principles of physical science persists notwithstanding it encounters insurmountable difficulties. Many problems defy the efforts of materialistic philosophers to solve them; the origin of matter and of motion; the initial source of energy as well as the relation of gravitation to other forces; the positive nature of the interstellar ether imagined as a vehicle for the transmission of light, not to mention proofs of its existence; the true inwardness of actinism, of Röntgenism, and of the rays named after Becquerel; the ultimate identity in es-

sence of the so-called elementary bodies. Some of these problems will undoubtedly be solved as knowledge of the material world increases, but others are destined to remain inscrutable to finite minds and as such may be called scientific 'mysteries.' We can construct ingenious arguments based largely on assumptions, and reason ourselves into the notion that our hypotheses explain the questions at issue, but after all we know very little beyond the effects observed.

These problems arise in every department of organized knowledge; the student of chemistry does not have to look far afield to encounter mysteries, though he does not commonly so styie them; phenomena of ordinary experience challenge the interpretation of philosophers. What do we actually know of the chemical force called affinity? Who can tell why the attraction between A and B is so much stronger than between A and C, or why one element forces another out of its combination with a third? What chemist who has watched under the microscope the beautiful, symmetrical manner in which minute particles of a substance separating in solid form from solution, arrange themselves in geometrical figures obeying well established mathematical laws, can pretend to explain the cause of the astounding behavior of the inert, lifeless matter?

But I desist from propounding further queries, the answers to which are buried in impenetrable mystery. A student of elementary chemistry, impressed with the ability of the teacher to explain natural phenomena, asked him: 'Professor, why is gold yellow'? Whereupon the professor, waiving the customary explanation [?], reverently answered: 'Because God made it so!'

Is it unfair to scientists to say that they sometimes take refuge in obscure language to veil their ignorance? It may help our imagination to affirm that carbon and other elements occur in 'allotropic' forms, but does this statement adequately explain the phenomenon? To term the peculiar action of certain bodies, which themselves suffer no change while they effect decompositions or combinations in others with which they are brought in contact, as 'catalytic' may be soothing to the mind, but is it scientific? Is it satisfactory? One hundred and fifty years ago the properties of water were said to be caused by its 'aquosity'!

In this study we have confined our illustrations to the physical and chemical branches of science, but they might well be drawn from astronomy and from the biological sciences; in the former, one becomes acquainted with

> "Realms yet unrevealed to human sight,"

as well as with the conception of infinity in space and in time; in the latter, one encounters the unfathomable mystery of the origin of life. It is evident that in pursuing any branch of knowledge the seeker has opportunities of familiarizing himself with ideas contained in the phrases, 'invisible world,' 'infinity,' 'mystery,' and with facts that require application of all the powers of the imagination and of reason, to grasp which he exercises faith.

Most scientists having this mental training, in which acts of faith are demanded at every step, find it natural to apply this faith to their hypostasis of the spiritual world; they thus acquire belief in an inscrutable Divine Being, who exercises almighty wisdom and power in the guidance of the material universe, and who has made Himself known to humanity by revelation. To such persons it does not seem more difficult to believe in spiritual force and its influence on mankind, than to believe in the existence of energy and its effects on matter. Huxley, who certainly can not be accused of religious bias, is said to have

remarked: "The doctrine of the immortality of the soul is not so wonderful as that of the conservation of energy or of the indestructibility of matter."

The evidence of the existence of spirit is precisely analogous to the evidence for matter; matter, as we have seen, is revealed to us only as its phenomena, extension, weight, color, behavior when subjected to heat, etc., affect our senses; of its essence we know nothing; spirit, likewise, is revealed to our consciousness through its powers of thinking, feeling and willing, but of the essential spirit the finite mind knows nothing. "Matter," writes an American scientist, "is the thing perceived, spirit the thing perceiving, matter is the passive, spirit the active principle. Without a belief in spirit, therefore, not only can there be no religion, no virtue, but there can be no philosophy or science. * * * The very origin of our notion of force is the consciousness of our own mental energy, and this universal energy of Nature is an effluence of the Divine Being."

Faith, both in science and in religion, is belief based on suitable evidence from sources outside of personal experience, both are fruitful in different ways, the former affecting the intellect and the latter the heart of man; scientific faith bears fruit in the steamship and in the telegraph, Christian faith in works of mercy and charity and in a life of love shown toward mankind and to God; it is

> "The subtle chain
> That binds us to the Infinite."

On the other hand, some students of science, accustomed to exercise faith in their attempts to solve obscure problems in the material world, hesitate (and a few refuse) to extend this intellectual power to the spiritual universe; this is undoubtedly due to the operation of the will, for

> "A man along that road is led
> Which he himself desires to tread."

The supreme goal of the student of science was admirably conceived and expressed in a single sentence by the renowned Kepler, when he wrote nearly three centuries ago:

"The scientist's highest privilege is to know the mind and to think the thoughts of GOD!"

H. Carrington Bolton.
Washington, D. C.

THE SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY.

The Society met, together with the American Society of Naturalists and the Affiliated Societies, at Johns Hopkins Medical School, Baltimore, Md., December 27–28, 1900, under the presidency of Professor D. P. Penhallow. There was a large attendance of members, and the meeting was in all ways profitable and successful. The presidential address dealt with 'A Decade of North American Paleobotany'; it was published in this Journal for February 1st. The most important business of general interest was the presentation of the report of the Committee (Messrs. Farlow, MacDougal and von Schrenk) appointed to consider methods of securing improvements in reviews of current botanical literature. Copies of the report were distributed to members present, and have been sent to other botanists throughout the country. It shows a completely successful result of the Committee's work, and comments upon it will appear later in this Journal. A committee was also appointed (consisting of Messrs. Ganong, Lloyd and Atkinson), to take into consideration the formulation of a standard college entrance option in botany. On Saturday, December 29th, the members of the Society, with guests, made an excursion to Washington, where they were shown the work of the Department of Agriculture, and were received by the Honorable Secretary for Agriculture,

who made a brief informal address. Later they were entertained at luncheon by the botanists resident in Washington. The following new members were elected: M. A. Carleton, Department of Agriculture, Washington, D. C.; F. D. Chester, Delaware Agricultural College, Newark, Del.; E. B. Copeland, University of West Virginia, Morgantown, W. Va.; T. H. Kearney, Department of Agriculture, Washington, D. C.; J. W. Toumey, Yale Forest School, New Haven, Conn. Officers for the ensuing year were elected as follows: *President*, Erwin F. Smith; *Vice-Presidents*, F. C. Newcombe and L. M. Underwood; *Secretary*, W. F. Ganong. The following papers were presented, the abstracts of which in most cases have been furnished by the authors:

Notes upon Albinism in Sweet Corn: PROFESSOR BYRON D. HALSTED, Rutgers College.

Complete albinism has been found in a sweet corn cross between 'black Mexican' and 'Egyptian' after the second year. The tests show that the albinos come from the white, pink and purple grains in about equal numbers and in some instances fifteen per cent. are white plants. These albinos have the normal vigor and in every way adhere to the type, except in the lack of a capacity to produce chlorophyll. They begin to lag behind their green mates after two weeks and perish a fortnight later. In the dark they grow like the normal plants, except that no etiolin is produced. A large number of seeds, germinated under unfavorable conditions, were not influenced in the percentage of albinos, and it seems quite certain that the albinism is acquired before the tests were made. Some ears in the lot of crossed corn produced no white plants, while others show many, and it seems to be a fact that grains from overburdened plants, *e. g.*, where there are three large ears, are more apt to produce albinos than those from stalks with a single ear. The cross may have been such that the last act in the drama of perfect seed-production was not reached. Again, the close breeding of the crossed grains, all plants in the plot being of the same mother and with no pollen from other plots, may have had its effect in the manner mentioned.

A Disease of the Locust: DR. HERMANN VON SCHRENK, Shaw School of Botany.

A destructive disease of the black locust (*Robinia Pseudacacia*), due to *Polyporus rimosus*, was described. The fungus destroys the heart wood of this tree, leaving a soft, yellow mass. The fruiting organs form on the trunk and larger branches for many years, discharging their spores in the summer and fall. Attention was called to the fact that the mycelium grows only in the heart wood of living trees, and dies as soon as a tree is cut down. This is probably due to changed conditions of aëration, moisture and temperature. This fungus must be considered as a special class of saprophyte.

Observations on the Mosaic Disease of Tobacco: MR. ALBERT F. WOODS, Department of Agriculture.

The author presented the results of numerous experiments showing that the mosaic disease of tobacco may be artificially produced in the following ways: (1) By cutting plants back during any stage of active growth, thus removing most of the reserve organic foods and stimulating rapid growth of lateral buds in the absence of sufficient albuminoid reserve. This causes a remarkable increase in the activity of oxidizing enzymes. These enzymes inhibit the action of the translocation diastase of the cells, thus preventing the movement and assimilation of starch. When a plant once reaches this stage it seldom recovers, all new growth becoming diseased. He was able to produce the same disease in

the same way, in tomato, potato, petunia, phytolacca, violet and other plants. (2) The disease may be reduced by repotting or transplanting a plant in active growth, thus stimulating a rapid root development. New leaves that form at this time often come diseased. Leaves that form at the time of the development of the flowers also often come diseased, as do also rapidly developing suckers. The pathological changes are the same in these cases as when the disease is produced by cutting back. (3) The disease may be produced by injecting the sterile juice of diseased plants into the growing bud or by pouring it on the roots. Perioxidase obtained from healthy or diseased plants and injected into the bud or poured on the roots may also cause the disease. The author concludes as follows: "The evidence which I have collected, taken along with that obtained by other workers, especially Mayer and Beijerinck, is therefore very strongly in favor of the infectious nature of the trouble under certain conditions. The matter can not, however, be considered as settled. So far as the evidence at hand goes, it appears that in growing cells there is possibly a definite relation between active oxidizing power, through the medium of oxidizing enzymes, and the availability of reserve food to the growing cells. It appears that this balance between the oxidizing enzymes and the availability of reserve foods can be broken by removing, on the one hand, the supply of reserve foods, in any way during growth, in which case the enzyme content of the cell is increased from two to four times the normal activity. This removal of reserve food may be either the result of diversion to other parts of the plant or of direct removal, as in the case of cutting back or of sucking insects, and possibly also can be brought about by other conditions not at present understood. On the other hand, the most remarkable thing is that the introduction of the enzyme in question (perioxidase) sets up the same series of pathological changes as is brought about by the removal of reserve food, namely, the increase of the normal enzyme of the cell, and the decrease of availability of reserve foods. When this pathological condition is reached it is very difficult for the plant to correct the trouble. The perioxidase probably moves from one part of the plant to another, though how much of the general spread of the disease in the plant is due to such movement has not been determined. The evidence of the communicability of this disease is quite as strong, if not stronger, than that upon which rests the belief in the communicability of ordinary variegation through grafting on healthy plants. The two groups of diseases are at least very closely related and are probably simply different phases of the same malady. Possibly peach yellows and the California vine disease belong here also and are to be similarly explained. Die-back of the orange may also belong here.

The paper was illustrated by two colored-plates and four half-tones, and will be printed as a bulletin of the U. S. Department of Agriculture.

Report of the Committee appointed to consider Methods of securing Improvements in Reviews of Current Botanical Literature: Presented by the Chairman, Professor W. G. Farlow, Harvard University.

This report has already been referred to, and a further account of it will be found in a later number of this Journal.

The Cause of the Red-brown Color in certain Cyanophyceae: Dr. G. T. Moore, Dartmouth College.

The various theories which have attempted to explain the cause of the red-brown color in *Anabaena*, *Gloiotrichia*, *Oscillatoria* and other so-called 'blue-green algae,' were discussed. It was shown that this

color could not be due to sulphur granules, as has been supposed,—neither was it possible to demonstrate any definite coloring matter within the cell itself. Numerous experiments with *Oscillatoria prolifica*, Gorn., a plant particularly favorable for study, showed that the red color must be caused by the refraction due to the presence of large numbers of gas vacuoles, as suggested by Klebhan. The effect of a large number of reagents, spectroscopical analysis and the examination of microtome sections, all strengthened this theory. As far as could be determined the enclosed gas seemed to be nitrogen. It would seem that the buoyancy common to so many Cyanophyceae, is particularly due to the presence of these vacuoles, for in material of the normal blue-green color the plants remained at the bottom of the dish, while those containing vacuoles and consequently of a red-brown appearance, always floated upon the surface.

Improved Methods for obtaining Pure Cultures of Fresh-water Algae: DR. G. T. MOORE, Dartmouth College.

The results of some methods for obtaining pure cultures of algae, by the modification of the nutrient medium, were shown. It was found that algae might be separated from contaminating forms by a very slight modification of the salts upon which they are grown. Luxuriant growths of Cyanophyceae were obtained upon a decoction of *Zamia*, with the addition of peptone and sugar. It required less than one-half the time for algae grown on this medium to nearly double the growth of those on mineral salt solutions. The possibility of using heat in separating blue-green algae from grass-green forms was also referred to.

A Second Preliminary Report on Plant Diseases in the United States due to Rhizoctonia: DR. BENJAMIN M. DUGGAR, Cornell University and MR. F. C. STEWART, New York Experiment Station.

This report presented notes upon the occurrence and destructiveness of American forms of *Rhizoctonia* observed by the authors. Since the first report (presented to this Society in 1898), the occurrence of *Rhizoctonia* on some entirely new hosts has been observed, and also upon other hosts new to America. As principal host plants among vegetables may be mentioned bean, sugar-beet, cabbage and cauliflower, carrot, celery, cotton, lettuce, potato, radish and rhubarb; and among flowers, asparagus, china aster, carnation, coreopsis, sweet william and violet; also about ten other less important hosts. In many cases the *Rhizoctonia* is truly parasitic and undoubtedly the cause of the disease in question, as has been abundantly proved by experiment; but in other cases inoculation experiments are yet lacking. Morphological studies and extensive inoculation experiments are in progress to determine more carefully the physiology of the forms and the limitations of species.

The Bacterial Diseases of Plants: DR. ERWIN F. SMITH, Department of Agriculture.

This consisted of a stereopticon lecture before a joint meeting of the Society for Plant Morphology and Physiology and the Society of American Bacteriologists. Three diseases were described, namely, the wilt of cucurbits due to *Bacillus tracheiphilus*, the brown rot of solanaceous plants due to *Bacillus solanacearum*, and the black rot of cruciferous plants due to *Pseudomonas campestris*. Fifty-eight slides made from the author's clear and beautiful photographs and photomicrographs were exhibited, showing symptoms, location of the bacteria in the tissues, etc. Many of these illustrations will be published in the near future in *Centralblatt für Bakteriologie*, 2te Abteilung.

Notes on the Life History of certain Uredineae: M. A. CARLETON, Department of Agriculture. (By invitation.)

Four species of rust fungi were investigated. In the case of *Uromyces euphorbiæ* Cooke & Peck, the well-known rust of *Euphorbia*, it was demonstrated by three separate series of experiments that the rust is able to propagate itself constantly through the germinating seed of its host, and therefore becomes in that way practically a perennial species. It is the only demonstrated example of this manner of propagation in the whole order of Uredineae. Actual cluster cups may be seen in the hulled seeds of *Euphorbia dentata*. Seedlings kept under bell jars become rusted three months from the date of planting, showing all stages of the rust, while seeds disinfected with mercuric chloride produce no rusted plants.

Culture experiments were also performed with the common sunflower rust, which showed that the *Puccinia* and *Æcidium* found on sunflower are stages of one and the same species. At the same time it is made probable that all the species of *Helianthus* affected bear the same rust and that there is no distinction of host forms. The peculiar, thick-walled, one-celled spores of *Puccinia vexans* Farl., have at last been successfully germinated after repeated failures, and it is now seen that these spores are neither properly uredospores nor teleutospores, but partake of the nature of both. They make up a distinct new spore form for this order of fungi, and may be called *amphispores*. True uredospores were also found and germinated. Other experiments and observations have shown that *Æcidium tuberculatum* Ell. & Kell. is commonly a perennial species in its perennial host *Callirrhoe involucrata*, producing spores able to germinate during the coldest winters.

Rheotropism of Roots: Professor Frederick C. Newcombe, University of Michigan.

The phenomenon of rheotropism is manifested by a curvature of the root when growing in streaming water. In all cases so far observed the response has been positive, *i. e.*, the root-tip curves against the stream. The present research has included 32 species of plants, of which 15 have shown themselves rheotropic and 17 insensitive. Nearly related plants behave similarly; but of two genera of the same family, one may respond to the current of water, and the other may be insensitive. Species differ greatly in degree of response. Members of the *Cruciferæ* are among the most sensitive plants found, their roots often attaining an angle of 90° from the vertical.

The velocity of current calling forth the best response lies between 100 cm. and 500 cm. per minute. A velocity of 2,000 cm. per minute will in most plants bring a mechanically negative curve, and the responses in currents less than 100 cm. per minute are weak and transitory. However, a velocity as low as one cm. per minute will bring a curvature in the majority of roots of the garden radish.

The latent period at the optimum temperature for growth is one hour or more.

The area which perceives the stimulus includes the apex of the root and the elongating zone.

Roots of mature plants as well as those of seedlings are responsive.

The author four years ago suggested that the stimulus might really be referred to the one-sided pressure of the water upon the root. Considerable evidence is now offered to confirm this view.

Thigmotropism of Roots: Professor Frederick C. Newcombe, University of Michigan.

Only two authors have claimed for ordinary roots the presence of sensitiveness to contact or pressure. Darwin believed he had found a negative response (a turning away), when the sloping side of the root apex touched a foreign body; and Sachs in a single and simple experiment found some

roots bending positively when a pin or a thin wooden rod was brought against the root 2 to 4 mm. back from the apex. Wiesner and others have shown Darwin to be mistaken, and the author of the paper here abstracted has repeated Sachs' tests many times without convincing results.

That roots are, however, responsive to pressure on the elongating zone can be shown by two kinds of experiments. Seedlings of buckwheat or radish are placed upright with their roots immersed in water, and a loop of very thin rice paper attached to a light pendulum is made to pull lightly on the elongating zone. Not more than half the roots bend, but all that do curve become concave on the side pressed by the paper. A better method is employed when gravitation is neutralized by revolving the seedlings in a vertical plane by the use of a klinostat. In this experiment the seedlings are supported in a damp chamber while their elongating zone rests lightly on a fixed glass rod. In sensitive roots, the tip of the root curves partially around the glass rod as growth goes on. These experiments show that some species respond and some do not respond to pressure. As far as the study has been carried, roots which are rheotropic are also thigmotropic. This agreement is strong evidence for the view that rheotropism is really thigmotropism. Neither rheotropism nor thigmotropism would seem to be of biological import to the plant. The response may be of the same class of phenomena as shown by tendrils when in contact with a solid object.

The Effect of Mechanical Shock on Longitudinal Growth of Plant Organs: DR. JAS. B. POLLOCK, University of Michigan.

The plant organs used were hyphæ of *Phycomyces*, hypocotyls of *Brassica*, *Raphanus*, *Helianthus*, *Lupinus*, and *Cucurbita*, the epicotyl of *Phaseolus*, and the leaf sheath and first leaves of *Avena* and *Triticum*.

Single shocks were given by pressure (*Phycomyces*) as by forcibly bending from side to side.

In *Phycomyces* there was a retardation after pressure, then a recovery in 5–30 minutes, usually in about 10 minutes, and the growth was then sometimes faster and sometimes slower than at first.

On bending, the larger plants first elongated considerably, were then retarded for a short time and recovered in 20–50 minutes, so they grew at a fairly constant rate, this rate being sometimes greater, sometimes less than at first.

Continuous shock was produced by several pieces of apparatus worked by electricity, water motor or clockwork, and was either a swaying from side to side or a jolting upon a board hinged at the middle.

The results were very decisive only in the case of *Cucurbita*, and showed a decided acceleration, due perhaps to the swaying from side to side. With all the other plants used the results were quite variable, but, taken as a whole, give evidence of acceleration as the result of not too vigorous swaying from side to side.

The Limits of Variation in Plants: DR. JOHN W. HARSHBERGER, University of Pennsylvania.

The study of the limits of variations in plants was undertaken as in part a contribution to the problem of species. It was stated, as a well-known fact, that more plants are produced than can survive, necessitating the destruction of many, and the survival of those that have fitted themselves by certain aptitudes to do so. As in part an answer to the evolutionary difficulty of small or initial variations, a careful statistical inquiry was made by comparative measurements of various plant parts. It was found, that the size and shape of leaves, the weight and size of fruits varied by mathematically ascertainable quantities. These

were determined for a number of plants and tabulated. It was discovered that in *Liriodendron tulipifera*, *Sanguinaria Canadensis*, *Ailanthus glandulosus* variations in the size and configuration of the leaves were in part due to the persistence of juvenile forms, to the arrested development of some leaves, and to their evolution and transformation to higher forms. The amount of these differences was ascertained, contrasted and tabulated. In conclusion, it was stated that these changes are in most cases due to two causes, viz., the internal hereditary impulse determining, as in *Ailanthus glandulosus*, the asymmetry of the lateral, paired, leaflets, and to the direct, environmental influence, fitting the leaf to utilize the space at its disposal, thus enabling it to present the largest amount of leaf surface to light action.

Critical Points in the Relation of Light to Plants: Professor D. T. MacDougal, New York Botanical Garden.

The following statements, upon the basis of accepted facts, may be made as to the influence of light upon plants:

1. Light exercises a direct chemical effect upon the substances of which protoplasm is composed.

2. It stimulates protoplasm to the formation of chlorophyll, although its action is not necessary to the process, and its direct chemical effect disintegrates this substance.

3. It constitutes a source of energy, which is absorbed by the chlorplasts.

4. Absence of light constitutes a specific stimulus, calling out the various reactions of etiolation.

5. Light acts as a directive or orienting stimulus to which the plant responds by locomotory or bending movements.

6. Different portions of the spectrum are operative in producing these separate effects.

If an examination is made of the facts upon which these generalizations rest, with reference to the current conceptions of *phototonus*, *paratonic influence* of light, *maximum*, *minimum* and *optimum*, it will be found that illumination is not necessary to the motility of protoplasm, and conversely that deprivation of light does not induce a condition of *rigor*, but sets up various pathological phenomena, among which is the breaking down of chlorophyll.

Light does not exert a paratonic or retarding effect upon growth. Its chemical action may hinder the accumulation of somatic material however. The altered development of plants in darkness is an adaptive response which has for its purpose the elevation of the chlorophyll screen and reproductive bodies.

Chemical, photosynthetic and phototropic maxima, minima and optima are so widely separated that *phototonus* as a term to designate the condition of a plant when acted upon by light of an optimum intensity, or of an intensity between the maxima and minima, is useless and untenable, as are also light optimum, maximum and minimum when applied in generality to the light relations of the plant.

Propagation of Lysimachia terrestris: Professor D. T. MacDougal, New York Botanical Garden.

The development of the secondary and tertiary branches of the stems of *Lysimachia terrestris* is arrested by conditions unfavorable to seed formation, and these branches assume the form of short cylindrical organs less than 1.5 cm. long without epidermal openings, and consisting of 3 to 5 internodes. The stele shows only protphloem and protoxylem. These bulbils fall to the ground and may survive under the cover of dead leaves to reproduce the plant in the next season. The bulbil completes its development as a rhizome and does not perish, as in most cases of bulbs and bulbils. Bul-

bils are quickly killed by desiccation and freezing temperatures.

Seedlings of Arisæma: PROFESSOR D. T. MACDOUGAL, New York Botanical Garden.

The seedlings of *Arisæma Dracontium* generally do not develop the plumule. The cotyledon pushes down into the soil carrying the hypocotyl, the base of which enlarges to form a bulb, in which is stored the reserve material withdrawn from the seed and not used. In a few instances, however, a single small leaf is developed; usually this does not take place until the second season of activity or the third season of existence of the seed. Similar saprophytism is exhibited by the seedlings of *Arum maculatum* which never develop the plumule until the second year of growth.

The Insular Flora of Mississippi and Louisiana: PROFESSOR FRANCIS E. LLOYD, Teachers College, and PROFESSOR S. M. TRACY, Biloxi, Miss.

The paper deals with the climate, physiography and the vegetation of the Mississippi Sound Islands and Delta, and is especially concerned with a comparison of the ecological conditions in this region and that recently studied by Kearney, namely, Ocracoke. The results show for the former a longer growing season, more favorable wind conditions and a greater amount of sunshine.

The islands of the Delta region are of three kinds, the sand islands, the muck-marsh islands and the mud-lumps.

These islands have a strand vegetation of which four formations are recognizable, viz., the beach, sand plain, dune and salt marsh formations.

The beach formation contains succulent annuals of a halophytic character such as *Suæda linearis*, *Salsola kali* and *Sesuvium portulacastrum*, and in its upper zone some tropical strand plants such as *Ipomœa pes-caprœ*, *I. acetosæfolia* (two prostrate leaf-succulent morning-glories), and rarely *Canavalia obtusæfolia*. The back beach plants are chiefly grasses, of which *Panicum amarum*, common along the north Atlantic Coast, and *Uniola paniculata*, a more southern strand plant, are the leading elements.

The sand plain contains succulent perennials as well as annuals, of prostrate and cespitose habit. The most striking plants of the sand plain are *Iva imbricata* and *Serenoa serrulata*, a prostrate palmetto, both of which build a pedestal dune.

The dune formation has two leading associations. One of these is the thicket (Ilex-Myrica) association inhabiting small established dunes which support a plentiful herbaceous undergrowth. The larger dunes are inhabited by *Serenoa serrulata*, *Rhus copalina* and several grasses. These dunes may attain a height of twenty meters and in their leaward march may bury the trees in their path.

The salt-marsh associations of chief interest are those of the muck-marshes. Two such are to be seen, namely the *Batis-Salicornia* association composed of leaf and stem succulents, and the grass association of which *Spartina* (two species) is the leading type. On the muck-marsh is sometimes superposed a water-moved shell dune composed of shell fragments and supporting a vegetation of annual and perennial plants of less marked halophytic character.

Some Problems connected with Fertilization in Plants: Lecture by PROFESSOR G. F. ATKINSON, Cornell University. (Illustrated by stereopticon.)

Professor Atkinson discussed recent advances which have been made in the study of fertilization in plants and their significance, and pointed out the problems still awaiting solution.

The Morphology of the Fruit of Opuntia: PROFESSOR J. W. TOUMEY, Yale University. (By invitation.)

Primarily the function of fruits is seed production, secondarily protection of seeds and aid in their dissemination. The fruit of the *Opuntia* does not deviate from this general law; although, in many instances, it has developed special adaptations. Under their desert environments, with many species, the germination of seeds and development of seedlings are rarely attained, the dependence for reproduction being almost entirely upon vegetal dissemination. In *Opuntia fulgida* the fruit is mostly sterile, but is particularly adapted to aid in the dissemination of the tumid spine-covered terminal joints, as these joints become attached to animals that feed upon the spineless fruit and thus become scattered by them. In this special case the function of the fruit is no longer to produce seeds, but to entice animals to the plant that the fragile, terminal branches may adhere to them and become disseminated. As before stated, the fruit is frequently sterile. In some instances, however, we find clusters of spineless, short, proliferous joints which resemble the fruits externally, but are entirely without evidences of even an abortive ovary. These proliferous clusters of spineless stems, in the economy of the plant, serve the same purpose as the fruit clusters and without the necessity of floral development, which would be a useless waste of energy on the part of the plant.

Notes on Long Island Pine Barrens: Dr. Hermann von Schrenk, Shaw School of Botany.

Photographs were exhibited illustrating the manner in which young trees of *Pinus resinosa* form basal shoots after the tops have been killed by fire. Some trees do this four years in succession, showing an unusual vitality in the root system. The effect of repeated fires on the barrens was discussed, and it was pointed out that a gradual degeneration of the forest is very marked.

Suggestions for an Attempt to secure a Standard College Entrance Option in Botany: Professor W. F. Ganong, Smith College.

The author pointed out the advantage to any science of the interest taken in its teaching by experts and scientific societies. The increasing use of botany as a college entrance option is emphasizing the lack of differentiation and definiteness in the secondary teaching of the science, as well as the diversity of requirement through which a great burden is placed upon those preparatory schools which fit students for a number of colleges. A summary is given of the requirements made in this subject by leading colleges. The history of the efforts to secure the formulation of a widely acceptable standard preparatory course was traced, culminating in the 'Report of the Committee of the National Educational Association in 1899.' The reasons why the latter is not more widely adopted were traced, and suggestions made as to the characteristics of a course likely to be more generally accepted. It was recommended that a committee be appointed to take the subject into consideration, and to endeavor to secure the formulation and adoption of such a course. This committee was appointed, as already mentioned in the introduction to this article.

Further Notes on Spermatogenesis of Zamia: Dr. Herbert J. Webber, Department of Agriculture.

The mature pollen grain of *Zamia* was found to contain two well-marked prothallial cells, and besides these a dark, refractive slit could frequently be observed in the wall of the pollen grain, at the base of the other prothallial cells, indicating that the first prothallial cell cut off becomes oppressed and largely resorbed during the development of the pollen grain as in *Ginkgo*.

These cells the writer referred to as the first, second and third prothallial cells, in the order of their formation.

During the development of the pollen tube and prothallial apparatus in the nucellar tissue after pollination, the second prothallial cell crowds out into the third prothallial cell which meanwhile retains its original point of attachment and comes to surround the second prothallial cell like a root-cap. When the third prothallial cell divides to form the stalk cell and central cell (Körper cell, generative cell), the spindle is formed diagonally in the cell, the nucleus of the forming stalk cell being crowded to one side by the intruding second prothallial cell. When the stalk cell is cut off by the completion of the division, it appears nearly cylindrical and completely surrounds the second prothallial cell except at the base, where both cells retain their original attachment. This same structure and development have been found by the writer to occur in *Ginkgo* also, and while in *Ginkgo* the division of the third prothallial cell has not been observed, the writer thinks there can be no doubt that the development is the same as in *Zamia*. This interpretation, it should be added, is totally different from that described by Ikeno and Hirase as occurring in *Cycas* and *Ginkgo*, but neither of these investigators observed the division of the third prothallial cell.

During the development of the apical end of the pollen tube in the tissue of the nucellus, the vegetative nucleus passes into the tube and during the growth of the latter remains near its apex. When the proximal end of the tube (the pollen grain end) begins to grow down toward the archegonia, shortly preceding fecundation, the vegetative nucleus travels back through the entire length of the tube, two or three millimeters, and takes position in the proximal end of the tube near the central cell. This change of position suggests that the nucleus governs and directs growth, and changes its location in the cell in order to be nearest to the point of most active growth, a factor emphasized by Haberlandt in his 'Function und Lage des Zellkernes.'

Notes on the Spermatozoids of Ginkgo: ERNST A. BESSEY, Department of Agriculture. (By invitation.)

In Washington the spermatozoids of *Ginkgo* are developed between August 25th and September 10th, as extremes, the most favorable time for finding them being September 1st to 3d. They are developed in the night or early morning. They are about 105×75–$82\,\mu$ in size, with nucleus 71–$75\,\mu$. The nucleolus is $7.5\,\mu$ in diameter. The cilia are about $15\,\mu$ long. There are three turns in the spiral band which bears the cilia. The spermatozoid has no tail such as Hirase described, the latter's observation being probably on injured specimens, as Fujii has recently pointed out.

The ciliar motions are the regular tremulous motions of the cilia and also a series of waves passing from the apex to the base of the spiral. The body of the spermatozoid is very movable, especially the ciliferous portion, twisting, bending, elongating and contracting very remarkably. At the base of the cell, exactly opposite the apex of the spiral, there is a trembling motion apparently coincident with, and connected with the movement of the cilia. Its significance has not been determined.

Spherites and Sphere Crystals and their Relation to Plant Structures: DR. HENRY KRAEMER, Philadelphia College of Pharmacy.

On the basis of their physical properties the author has grouped the substances making up the contents and walls of plant cells into (1) the cell liquids or cell fluids; (2) sphere crystals; and (3) spherites. The cell liquids include the organized contents of the cell and a portion of the unorganized contents as cell sap. The sphere

crystals are spherical aggregates of crystals with sharp angular contours, which are made up of but one substance and include various calcium salts, alkaloids, glucosides, etc.

The spherites resemble somewhat the sphere crystals, but are distinguished from them by the fact that the molecule is complex and the individual crystals have either a somewhat rounded outline or are imbedded in colloidal substances in which the crystalline or crystalloidal character is more or less obscured and hence with difficulty discerned. These include inulin, starch and the principal substances entering into the composition of the cell wall. The spherites are further distinguished from the sphere crystals in that they are capable of taking up or holding certain coloring principals as safranin, gentian, violet, etc.

The mode of formation of spherites and sphere crystals appears to be the same whether observed in nature or as carried out artificially by crystallization of salts from solutions or by precipitation, and hence the conclusion is reached that there is a play of similar forces in their formation.

An examination of the crystal masses remaining in watch crystals after the spontaneous evaporation of various substances under varying conditions, shows not only the formation of crystals which resemble those produced in the plant cell, but other rather striking forms of combination which are very suggestive indeed. Indeed the arrangement of the crystals in such a watch crystal reminds one of the appearance of our woods, at this season of the year, when the absence of leaves permits the observance of the fundamental lines of development in shrubs and trees.

The Cardinal Principles of Morphology: Professor W. F. Ganong, Smith College.

Although in most of its phases botany is making remarkable advances in America, it is still in one respect very backward, namely, in the morphology of the higher plants. Not only is little research being carried on in this direction, but it is still treated, particularly in its teaching, in the old formal idealistic manner, with little of the modern realistic spirit which the research of the past quarter century has infused into it elsewhere. The characteristics of the two systems, which differ less in fact than in point of view, are contrasted, and the attempt made to reduce these characteristics to definite named principles. Of these principles the author recognizes seven, in five of which the two systems do not differ materially, but in the other two they differ greatly. These are, the principle of metamorphosis by transformation or alteration as contrasted with metamorphosis by differentiation, a principle which is fundamental with the modern school of morphologists of which Goebel is the leader, and the principle of the existence of degrees of morphological rank culminating in morphological independence to which any part may attain. On this principle any part may become a center of variation and modification, and hence a true morphological member, and the number of members is not limited to three or four for the higher plant, as generally taught by us, but is indefinite.

Relation of Water-plants to the Solid Substratum: R. H. Pond, Maryland Agricultural College. (By invitation.)

Many of our well known text-books contain the statement that the roots of water plants serve for attachment only; that the function of absorption is unnecessary because transpiration is absent and the plant is bathed in a nutrient solution.

The evidence now at hand seems to require a modification of this statement. Six of our common and widely distributed

aquatic species have been investigated. The results in general are:

1. Plants rooted in soil exceed in vegetation and dry weight plants rooted in sand or merely suspended.

2. Plants rooted in sand or merely suspended contain starch, calcium and magnesium in excess, while they are lacking in nitrogen, potash and phosphoric acid.

3. Lithium nitrate is absorbed by the roots and conducted to the upper portions of the plant where it may be detected with the spectroscope.

4. A volumetric measurement of root absorption has been made.

The work which has yielded these results has been done by the author while a special assistant to the U. S. Commission of Fish and Fisheries.

Positive Geotropism in the Hypocotyl: PROFESSOR E. B. COPELAND, University of West Virginia. (By invitation.)

The curve by which the primary root is bent downward if it emerges from the seed in any other direction is usually executed in the hypocotyl. By decapitation experiments and by a careful study of the location of the curving region, with reference to the growing tip, it is shown that the stimulus causing this curve is received by the root tip. To distinguish between the parts played by the root tip and the hypocotyl Czapek's terminology is adopted, the latter being geotropic, the former, geoæsthetic. The positive geotropism of the cotyledon of the date and other plants, where it is the first part of the embryo to elongate actively, is explained in the same way; the stimulus is received by the root tip, and the response is executed in the elongating zone above it, which is here in the cotyledon.

The Toxic Action of certain Salts on Marine Algæ: DR. BENJAMIN M. DUGGAR, Cornell University.

Plasmolytic studies upon some marine algæ at the Naples Biological Station demonstrated that KNO_3 is too toxic to be used for such work. This led to a study of some of the common nutrient salts as toxic agents in comparsion with some salts of the heavy metals and with certain acids.

In general the results indicate that potassium salts are much more toxic than those of sodium and magnesium. All the algæ used were killed by an exposure of three days in $\frac{n}{25}$ K_2HPO_4 in sea water K_2SO_4, KNO_3, and KCl were also toxic in a slightly decreasing ratio. With the magnesium and sodium salts used, and for a similar period of time, no injury occurred at $\frac{n}{5}$. Salts of the heavy metals were much more toxic than for the fungi; and in general, the acids used were very slightly toxic at $\frac{n}{1000}$. With no salt tested was it possible to keep the plant alive for more than a few hours in a solution of that salt isotonic with sea water. *Griffithsia Schousberi*, *G. opuntioides*, *Pleonasporium coccinium*, and *Chætomopha* sp. were the algæ used.

Loss of Vigor in Corn from Inbreeding: DR. HERBERT J. WEBBER, Department of Agriculture.

In maize the loss of vigor caused by close inbreeding was found to be very marked. Seeds of Hickory King, a race grown commonly in the eastern States, produced by inbreeding with pollen of the same stalk, yielded the next year at the rate per hundred stalks of 46 ears, weighing 9⅓ pounds. Seeds of the same race in every way comparable, but produced by crossing different seedlings, yielded under the same conditions at the rate per 100 stalks of 82 ears, weighing 27½ pounds.

In attempting to fix hybrids of Hickory King ♀ × Cuzco or Peruvian Corn ♂, some ears were inbred with pollen from the

stalks bearing them, while others were pollinated with pollen from other hybrid seedlings of the same parentage. The hybrids of the second generation, where the seed was inbred with pollen from the same stalk, showed great loss of vigor, being small in stature and almost totally sterile; while those produced from seed which was inbred with pollen from a different seedling were much more vigorous and productive, seeming to have lost but little by this process of inbreeding.

Judging from these observations, it would seem that in fixing corn hybrids in practical plant-breeding it will be found desirable to cross different hybrid seedlings of the same parentage, which are found by careful observation to present the same characters, rather than inbreed a hybrid with its own pollen, as is somewhat generally directed by plant-breeders. It is of the utmost importance in plant-breeding that the best methods of fixing hybrids of various kinds of plants be determined, and further observations on this point with other plants are greatly needed.

W. F. Ganong,
Secretary.

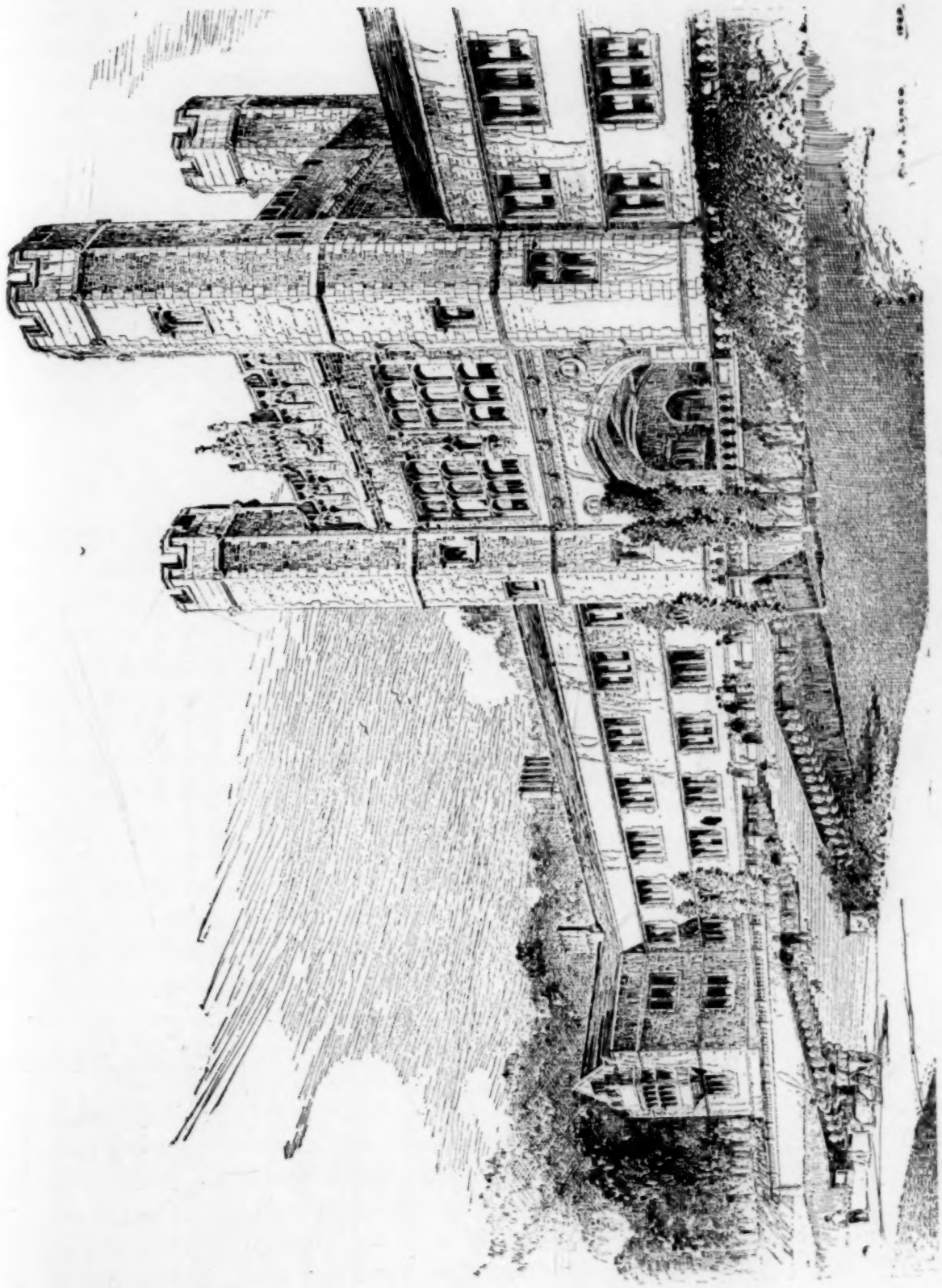
WASHINGTON UNIVERSITY.

The new grounds of Washington University are situated at the western boundary of the city just west of Forest Park. The distance from the Mississippi River is about six miles and from the business center of the city about five miles. The most direct approach from the city is along Lindell Avenue. The site covers 153 acres and cost $350,000. The eastern boundary of the ground is Skinker Road, from which the land rises rapidly westward for about 1,000 feet. About 1,200 feet from Skinker Road is placed the main building of the institution, to be called University Hall and to be devoted to the offices of administration and to those subjects which do not require a laboratory or a drawing room. This building forms the eastern side of the first quadrangle; the other buildings on this quadrangle are Busch Hall, to be devoted to chemistry, Cupples Hall No. 1, to be devoted to Civil Engineering and Architecture, and the Library which separates the first quadrangle from the second.

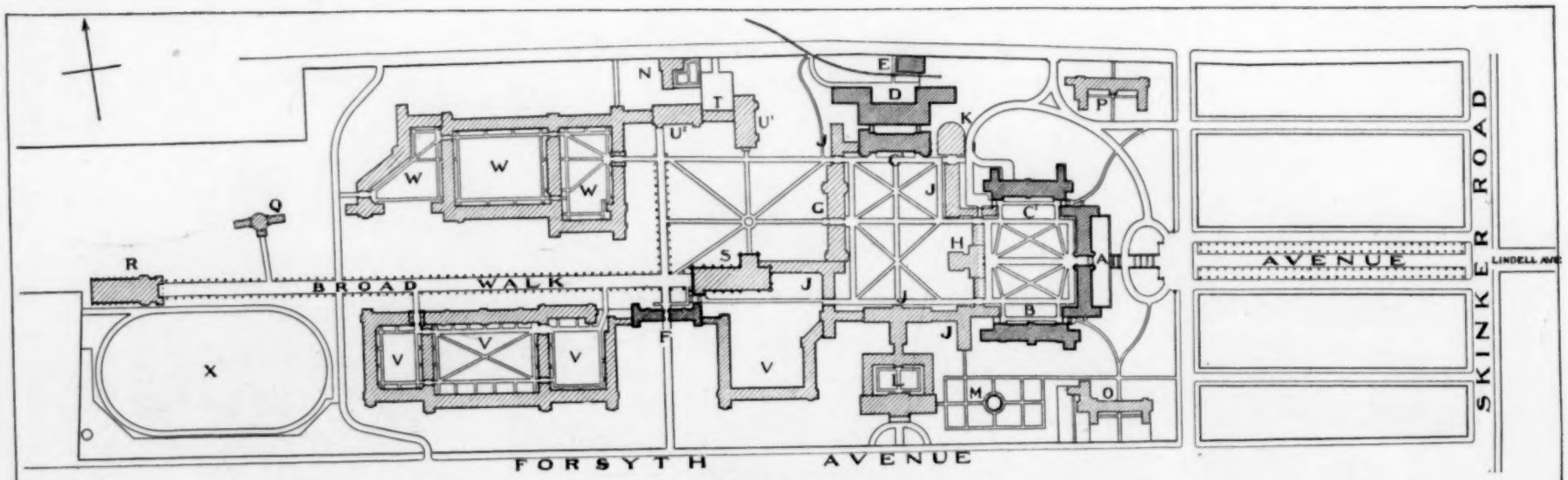
On the second quadrangle are also to be Cupples Hall No. 2, which is to be devoted to electrical and mechanical engineering, a building for physics, and sites for other buildings not yet planned. The first and second quadrangles are to be devoted exclusively to buildings for instruction. The other quadrangles are to be devoted to dormitory buildings. Those to the north of the Broad Walk are intended to be occupied by women students and those to the south of the Broad Walk by men students. The Broad Walk, something over a third of a mile long, leads to the gymnasium, near which is the athletic field, which will be excavated in the top of the hill in the form of an amphitheater. The architects, Messrs. Cope & Stewardson, of Philadelphia, have so arranged the quadrangles as to occupy the highest land of a long hill whose general direction is east and west.

Seven of the buildings shown on the general plan are to be constructed at once, and five of them are already under construction. The St. Louis, Kansas City and Colorado Railroad, running along the north line of the property at the bottom of the hill, makes it easy to bring in the supplies for the University. The power house, located beside the railroad track, will provide heat, light and power for all the buildings. The buildings generally will be two stories high on the quadrangles and three stories high on the opposite sides. The buildings to be erected immediately will cost about $700,000, and about $100,000 will be expended in the grading and planting of the grounds.

The style of architecture is what is called



University Hall, Washington University.



BLOCK PLAN
WASHINGTON UNIVERSITY
ST. LOUIS
SEPTEMBER 1900.

SCALE: 1 INCH = 100 FEET. COPE & STEWARDSON, ARCHITECTS.

INDEX.

A—University Hall — Administration.
B—Busch Hall—Laboratory of Chemistry.
C[1]—Cupples Hall, No. 1—Civil Engineering and Architecture.
C[2]—Cupples Hall No. 2—Mechanical and Electrical Engineering.
D—Laboratories of Mechanical and Electrical Engineering.
E—Power House.
F—Liggett Hall—Men's Dormitory.

Now being erected.

G—Laboratory of Physics.
H—Library.
J—Position of Future Extension of Scientific Schools.
K—Auditorium.
L—Museum.
M—Botanic Garden.
N—Gardener's House.
O—Instructors' Houses—Men.
P—Instructors' Houses—Women.

Q—Observatory.
R—Gymnasium.
S—Chapel.
T—Kitchen Service.
U[1]—Commons Hall—Men.
U[2]—Commons Hall—Women.
V—Dormitories for Men.
W—Dormitories for Women.
X—Athletic Field—Running Track, 3 laps to the mile.

Tudor Gothic which appears so prominently in the buildings of the Universities of Oxford and Cambridge. The amount of cut stone in the buildings will be large; the material used for this purpose comes from the Bedford quarries of Indiana. The field of the walls is to be of rubble masonry of red Missouri granite. It is expected that the five buildings now under way will be completed in about one year.

Besides these gifts, the University has recently received gifts for its endowment fund of three and a half million dollars, part available at once and part available after a few years.

W. S. CHAPLIN,
Chancellor.

THE BUSCH CHEMICAL LABORATORY.

THE new chemical laboratory of Washington University, the plans of which appear in this number of SCIENCE, is the generous gift of Mr. Adolphus Busch of St. Louis, who has given the University $100,000, for its construction and equipment. The building is situated on the south side of the university quadrangle, and as the ground slopes away on this side, the new laboratory is two stories high on the north front and three stories on the south. Directly opposite on the quadrangle is the Cupples Hall No. 1 devoted to Civil Engineering and Architecture, while adjoining it on the east is the large and beautiful University Hall. The windows of the Busch laboratory command a beautiful view of the campus to the north and west, while to the south and east they overlook the wooded hills of Forets Park. The laboratory stands to-day as an enduring monument to the liberality of Mr. Busch.

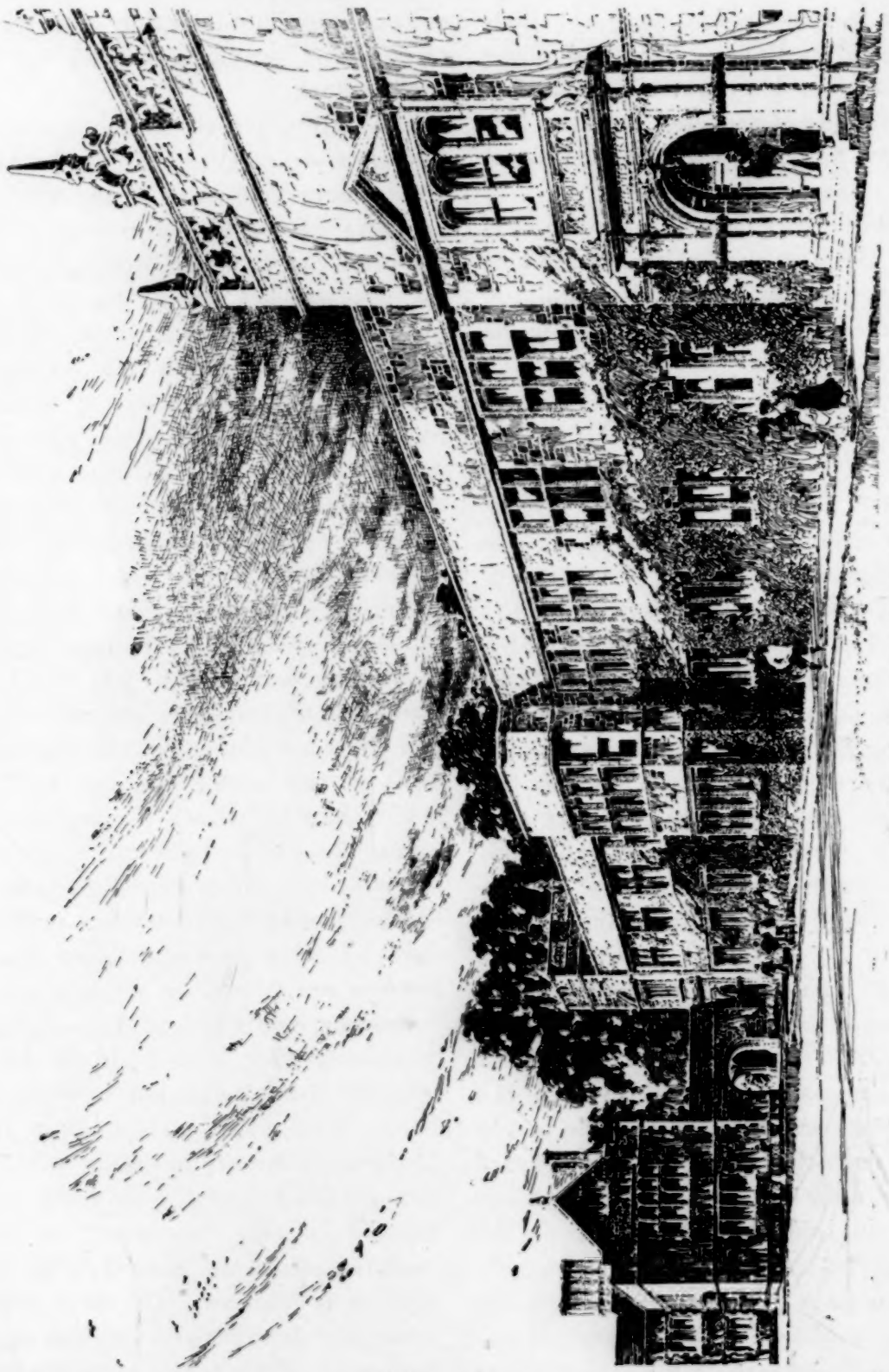
The architects of the building are Messrs. Cope and Stewardson of Philadelphia and St. Louis, who a few years ago designed the John Harrison Laboratory of Chemistry of the University of Pennsylvania. In planning this laboratory they have retained all of the desirable features of the Pennsylvania laboratory, they have avoided everything that experience has shown to be undesirable and have in a number of ways improved upon their earlier work.

The building is of Tudor Gothic design, the walls are of Missouri granite, the ornamental cut stone work of the windows and doors is of Bedford limestone. It is of fire-proof construction throughout. From the illustrations it will be seen that the building is long and narrow. The length is 291 feet and the width 60 feet. This plan was adopted in order that all the rooms may be well lighted, and since the main length of the building extends from east to west, a long north front with ample window space is secured for the main working laboratories.

Entering at the east front door, one finds immediately on the left the large lecture theater, a room 46 feet by 30 feet 10 inches. The rows of seats rise one above another, and there are places for 186 students. The front of the lecture room is half a flight lower than the rear. Immediately in the rear of the lecture theater and communicating with it is the preparation room. Here the lecture experiments are prepared and the apparatus and chemicals used in the lectures are stored.

Passing westward in the main corridor on the first floor, one finds on the right a large laboratory devoted to general chemistry. This room is 130 feet 6 inches by 18 feet. Here are working tables for the accommodation of 125 students. The new feature in this laboratory is that each working table is placed with one end against a window. On each side of the table are drawers and cupboards for four students. Each table, having a window at the end, is well lighted, and no student works further than twelve feet from a win-

dow. On the wall opposite the windows there is a continuous line of hoods extending from one end of the room to the other.

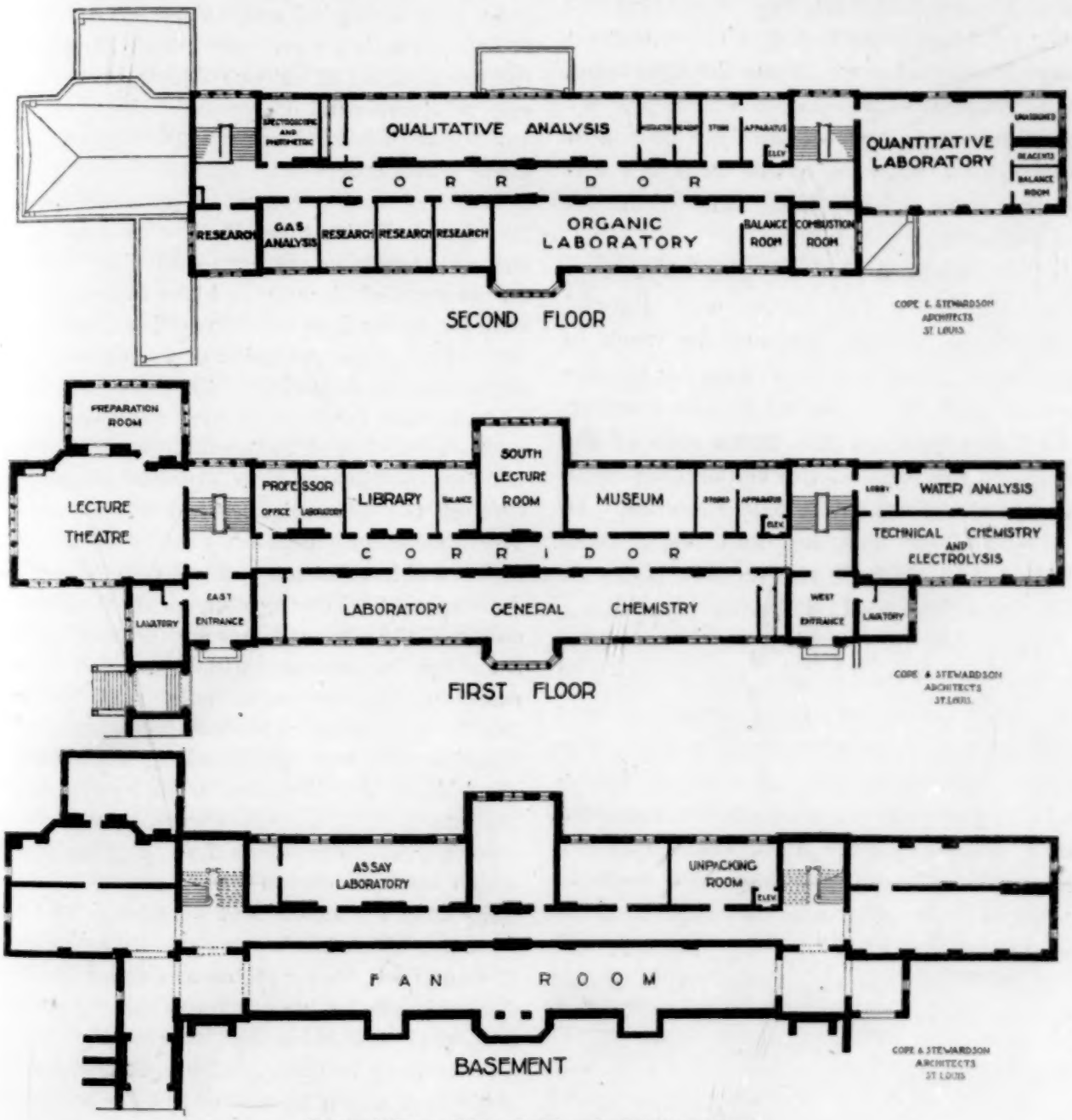


The Busch Chemical Laboratory.

At each end of this large laboratory there is a small room, one of these is used as a hydrogen sulphide room, the other as a storeroom for keeping the stock bottles of reagents.

On the south side of the corridor are the professor's office and private laboratory,

the library and balance room, a lecture room, 23 feet by 32 feet, seating 60 students, a museum and storerooms for apparatus and chemicals. At the west end of the building and half a flight lower there dows on the north and south sides. This is the laboratory for quantitative analysis, and communicating with it at the western end are smaller rooms for balances, reagents and a private laboratory for the in-



Ground Plan of Busch Chemical Laboratory.

are rooms for special kinds of chemical work, such as water analyses, electrolytic work and technical chemical operations.

Ascending the western stairway one-half flight, one reaches a large room, 41 feet 9 inches by 32 feet, lighted with large win-

structor. On the main second floor there are two laboratories, one of these, with working tables for sixty students, is devoted to qualitative analysis, the other, with places for thirty students, is arranged for work in organic chemistry. As

in the large laboratory on the first floor, the tables have their ends against the windows and the hoods extend along the interior walls. On this floor there are also four smaller rooms for research work, a room for photometric and spectroscopic work, a balance room, a room for organic combustions and store rooms for apparatus and chemicals. These last are immediately over the store rooms on the first floor, and communicate with them and with the unpacking room in the basement by means of an elevator.

In the basement, besides the unpacking room, there are two large well lighted rooms fitted up with furnaces for work in assaying. There is also a room for the apparatus used in preparing distilled water.

In the rooms on the north side of the basement are located the ventilating fans. These are driven by electric motors. In the system of heating and ventilating adopted cold air from the outside is drawn in by the fans and is forced over steam radiators and into the rooms. The warm air enters the rooms near the ceiling and the outlet flues have their openings near the floor. A separate system of fans, also driven by electricity, is placed immediately under the roof. These are connected with the hoods and with the hydrogen sulphide room, and they have been so arranged that they can be made to draw air from all the hoods or they can be made to draw simultaneously from the hoods of any one laboratory.

Edward H. Keiser.
Department of Chemistry.

SCIENTIFIC BOOKS.

Ueber die Natur der Centrosomen. By Theodor Boveri. Zellenstudien, Heft 4. Fischer, Jena. 1901. Pp. 220, 8 plates, 3 text-figures.

Probably the most remarkable series of cytological papers yet published by a single author are the 'Cell-Studies' of Theodor Boveri, which have placed before students of cellular biology not only a wealth of original discoveries, but also a model of critical analysis and lucid exposition that has hardly been surpassed. They form to-day a fine example of the value of intensive work in this field, for although they have extended over a period of nearly fifteen years they have been mainly devoted to the examination of but two objects, namely, the eggs of *Ascaris* and of the sea urchin; yet few works have accomplished more for the advancement of the general subject.

The first three parts, which appeared successively in 1887, 1888 and 1890, were inspired by the epoch-making res arches of Van Beneden on the eggs of *Ascaris*, and the first two were entirely devoted to the same object. The first cleared away the confusion of the earlier work regarding the formation of the polar bodies and laid the basis for most of the subsequent work on the reduction of the chromosomes, a subject which was thrown into especial prominence through the theoretical essays of Weismann. The second was a masterly study of the phenomena of fertilization and cleavage, with a full development of the hypotheses of the individuality of the chromosomes and of fibrillar contractility in mitosis, which exerted a far-reaching influence on all subsequent work in this field. The third placed upon a broad comparative basis the epoch-making discoveries of himself and Van Beneden on the equivalence of the paternal and maternal chromosomes in fertilization ('Van Beneden's Law'). The fourth, which appears eleven years after the third, deals with the nature and function of the centrosome, which has become one of the most difficult and perplexing problems of cytology. Students of cellular biology have eagerly awaited a critical discussion by Boveri of the later and in many respects conflicting aspects of this subject, in which he was one of the ablest pioneers. The present work contains a detailed study of the centrosomes in the segmenting eggs of *Echinus* and *Ascaris*, a valuable critique of technical methods, and a critical examination of the literature, with chapters on the structure and division of the centrosome in general, its relation to cell-division, its origin and physiological activity, and related questions.

All these matters are treated in the lucid and attractive style characteristic of the author, and the work easily takes its place as a worthy companion to its predecessors.

The portion of the work that will be read with greatest interest is that which deals with the vexed question as to whether the centrosome is a permanent cell-organ, comparable with the nucleus in point of morphological persistence. The independent discovery by Van Beneden and Boveri in 1887, that the centrosome in the *Ascaris* egg is such an organ, since extended to many other cases, was at first hailed as the most important step taken since the establishment of genetic continuity in the case of the nucleus. That a like principle applies to the centrosome, as was first stated by Van Beneden and Boveri, has been widely accepted by cytologists, but of late years a marked reaction against this view has taken place, a considerable number of competent observers having been led to conclude that centrosomes may form *de novo*, as well as by the division of pre-existing centrosomes. While recognizing that the centrosome theory has been in some directions pushed too far, Boveri regards the present reaction as a backward step. Nevertheless, in the course of a highly interesting discussion, he makes a large concession to the advocates of formation *de novo*, though his general theory is developed with the utmost ingenuity so as to save the principle of genetic continuity for which he has always contended. He sharply distinguishes between a protoplasmic (cytoplasmic) and a nuclear origin of centrosomes. While formation of centrosomes *de novo* in the protoplasm is denied, such an origin is admitted in case of the nucleus, though with qualifications that involve only a modification and not the abandonment of his original theory.

The strongest evidence in favor of the cytoplasmic formation of centrosomes *de novo* is afforded by the observation of the American observers, Lillie, Mead and Morgan; but all arguments based on this evidence are regarded as 'in high degree vulnerable.' The multiple asters observed in the eggs of *Chætopterus*, *Arbacia* and other animals are believed by Boveri to be 'almost certainly' of two kinds, the one (polar asters, cleavage-asters) being true asters arising through the activity of the egg centrosome or its derivatives, the other being 'pseudospheres' of different nature from the former and containing no true centrosomes. All arguments based on the apparent disappearance and reappearance of the centrosomes in the cytoplasm during fertilization (as described for instance, by Lillie and MacFarland) are regarded as having little weight, in view of the impossibility of distinguishing the centrosome amid other granules when not surrounded by astral rays. On the positive side the persistence of the centrosome in *Ascaris* is once more demonstrated, step by step, throughout the first cleavage, and the same phenomenon is for the first time fully demonstrated in the egg of the sea urchin (*Echinus*) which, as Boveri emphasizes, is one of the most difficult of objects. These cases are illustrated by a large number of new and very convincing figures.

When Boveri turns to the nuclear origin of centrosomes he takes a different ground, basing his conclusions on the absence of centrosomes in the higher plants, on the phenomena of division in the Protozoa and on the experimental evidence brought forward especially by Hertwig and Ziegler. This interesting discusson is based primarily on the fact that in Infusoria and some other Protozoa a spindle is formed from the achromatic substance of the elongated nucleus, the bipolarity of the division figure being determined by the nucleus without the appearance of individualized centrosomes; and with this is compared the formation of the polar spindle in the eggs of *Ascaris*. To such a spindle the new term 'netrum' is applied (*νῆτρον*, spindle), and its mode of origin is assumed to be a primitive mode of spindle-formation to which all other types may be referred. The accumulation of substance at the poles of such a spindle to form 'pole-plates,' as occurs in some Protozoa, represents an incipient centrosome-formation, with which is compared the peculiar mode of division of the centrosome in *Diaulula* as described by MacFarland. In the latter case the centrosome is extra-nuclear, but its mode of division closely resembles the phenomena observed in Infusoria, the mother-centrosome elongating to form bodily the spindle from the ends of which are differentiated the daughter-

centrosomes. This case gives the transition to the usual types (*Ascaris*, cleavage, etc.) where the extra-nuclear centrosome divides bodily.

Boveri is thus led to regard the centrosome of the higher types as equivalent to the intranuclear material from which the 'netrum' of the lower types (Infusoria) arises, and he characterizes the nucleus of the latter as a 'centronucleus'—a view which is nearly identical with that of Richard Hertwig. In the higher types in general, individualized and permanent centrosomes have been differentiated, and as it were emancipated, from the primitive 'centronucleus,' and as a rule lie outside the nucleus in the cytoplasm; but the nucleus has in some cases retained the power to give rise, upon occasion, to a karyokinetic spindle (as occurs in the polar spindles of *Ascaris*), or even to produce new centrosomes. This, Boveri believes, is the case with the egg-nucleus in echinoderms, and he would thus explain the division figures formed as a result of chemical stimulus. In normal fertilization, on the other hand, the centrosome-producing power of the egg-nucleus remains latent, since the spermatozoon imports an active individualized centrosome. How far the nuclei of higher forms in general have remained 'centronuclei' and still possess the power of forming centrosomes, how far they have lost this power, remains to be determined; but Boveri does not consider it probable that such a mode of centrosome-formation is widespread. It is worth pointing out that Boveri regards as not improbable the view of Calkins that phylogenetically the primitive form of nucleus (centronucleus) may have arisen through the union in one body of a cytocentrum and other elements (chromatin) originally scattered through the general cell substance.

It is evident from the foregoing that the original centrosome theory of Van Beneden and Boveri, as commonly understood, has thus undergone a considerable modification, which will very likely be regarded by some readers as a virtual abandonment of that theory. Such is not, however, Boveri's own view. "Strictly speaking the cases in question do not involve a new formation. For even though the centrosome may not preexist as an individualized structure, it does not arise as something really new * * * but only by the final transformation of a preexisting cytocentrum" (p. 193).* If, however, we accept the widely held view that the achromatic nuclear substance is closely related to the cytoplasm, the step does not seem very great from the formation of 'individualized' centrosomes *de novo* out of the achromatic nuclear material to such a formation in the cytoplasm. Boveri's denial of such cytoplasmic centrosome-formation rests upon a series of assumptions, some of which are opposed by the recent discovery that Morgan's 'artificial astrospheres' may multiply by division, even in enucleated egg-fragments. He has nevertheless entrenched the centrosome theory in a strong position, from which it can only be dislodged by a stronger attack than has yet been made upon it.

Other valuable discussions deal with the relation of centriole and centrosome, and of centrosome and sphere, and with the physiological activities and cyclical changes of the centrosome. Without attempting to review these *in extenso* it may be pointed out that Boveri holds fast to the view that the centrosome passes through a regular cycle of changes, during one part of which it is a body of considerable size within which lies a smaller 'centriole.' He repudiates some of the interpretations that have been placed by other writers upon his own earlier observations, and identifies his 'centrosome' with Van Beneden's 'corpuscule central,' and not with the latter author's 'medullary zone' of the sphere. He overturns Kostanecki's and Siedlecki's contention that the size of the centrosome depends merely on the degree of extraction of the hæmatoxylin or other dye, by the highly important observation that when at its greatest size the centrosome in *Ascaris* is clearly visible not only in unstained material but also *in the living object*. He believes that the so-called pluricorpuscular centrosome, such as he himself and others earlier described in echinoderms, is an artifact; but his observations justify some severe strictures that are passed on the scepticism of such writers as Fischer, who have more than hinted that the centrosome itself is an artifact. Fischer's valu-

* For a related though not identical interpretation see Wilson, 'The Cell,' pp. 111, 215.

able experiments, with those of Bütschli, Hardy and others, have shown how much caution is necessary in the interpretation of the coagulated material observed in sections; but they have produced in some minds a pessimism regarding the morphological investigation of the cell that is without justification. The cyclical changes observed in sections of fixed material are not a matter of chance, but form a highly significant connected series, and many of them have been fully confined by comparison with the living material. The experiments in question have provided us with a valuable critique of our methods, but have not destroyed their value. Even though we may not agree with all the conclusions set forth in the present paper, we must regard it as weighing heavily on the side of the view that the cell possesses a definite and complex morphological organization that passes through perfectly ordered cyclical changes, and of which our cytological methods give us not indeed a photographic image, but still a definite record.

EDMUND B. WILSON.

Elements of Mineralogy, Crystallography and Blowpipe Analysis. By ALFRED J. MOSES and CHARLES L. PARSONS. New York, D. Van Nostrand Co. 1900.

The edition of the book before us is in plan essentially like the former edition of 1895. Many parts have, however, been re-written and considerable additions are to be noticed in text and illustration.

The part devoted to crystallography has undergone complete revision, and in its treatment of the subject conforms to the prevailing classification. Over one hundred figures, for the most part excellent, have been added and we are pleased to note a new chapter treating entirely of twin crystals. The chapters on blowpipe analyses treat of the apparatus used in, and the operations of, blowpipe analyses. A summary of blowpipe tests is also given with a short scheme for qualitative blowpipe analysis.

The descriptive mineralogy opens with chapters treating of the various characters of minerals, that on optical characters being intended as introductory to a subsequent study of minerals in thin sections under the microscope. In the part describing the individual minerals we find them grouped according to the economic classification, viz., iron minerals together, copper minerals together, etc. Before each group a brief discussion is made of the uses of the particular metal in hand, the minerals from which it is obtained and the metallurgical processes involved in its production. We think this an excellent feature of the book. The silicates do not yield to such a classification and are grouped according to the usual chemical classification. While the descriptive part as a whole and in many of its details seems to us excellent and worthy of commendation, we can not but express our regret that it should be marred by so many poor illustrations. The crystal drawings are excellent, but with few exceptions the other illustrations are not what they should be. It is doubtless difficult to represent the characteristic appearance of a mineral on paper and unless great pains is taken in this regard it were better for both books and mineralogy not to attempt such illustration.

In describing the crystallization of the minerals we notice that the real angle between the crystal faces are given instead of the supplementary angle as is customary. As the latter angles are the ones most convenient for use in calculation it would seem desirable to have had them given.

The book is concluded by a series of tables designed for the rapid determination of the common minerals.

C. H. W.

A Text-Book of Important Minerals and Rocks. By S. E. TILLMAN. New York, John Wiley and Sons; London, Chapman & Hall. 1900.

Professor Tillman has prepared this book with the idea of furnishing the general student of mineralogy with a convenient and serviceable book, condensed in form, yet sufficiently complete in descriptive matter to equip the student with a good general knowledge of the subject.

The opening chapter consists of a very brief outline of the crystallographic character of minerals. The second treats of other physical characters and of the chemical properties of minerals. With the latter is included a brief description of blowpipe and chemical tests. That four pages should be deemed sufficient for

the treatment of a subject so very important is rather astonishing, and it is the deficiency in this regard that will we fear detract from the general usefulness of the work. The main part of the book contains the descriptions of the individual mineral species, of which some seventy-five are described, and their occurrence and uses commented on. A series of tables for the determination of the minerals, chiefly by means of their physical characters, are included in the descriptive part and is designed to supplement the latter. Part II. furnishes a brief description and classification of the more common rocks. C. H. W.

Lehrbuch der anorganischen Chemie. Von Professor Dr. H. Erdmann, in Halle. Zweite Auflage, mit 287 Abbildungen, einer Rechentafel und sechs farbigen Tafeln. Braunschweig, Druck und Verlag von Friedrich Vieweg und Sohn. 1900.

To quote from the author's preface. "First of all a text-book of chemistry should give reliable data concerning the properties and reactions of substances; here were gaps to be filled, for our larger manuals generally take without criticism the frequently contradictory statements and figures of different authors. The most accurate data, however, remain lifeless matter for reader and student unless the book explains the occurrence of substances on a geological basis, gives due attention to their therapeutic and toxic properties, and due recognition of their importance for the common weal by a consideration of their varied application, and by statistics of production and price; nor should the historical aspect of the subject be neglected."

Through certain improvements in this edition "somewhat more space could be devoted to those theories which have sprung up on the boundary space between physics and chemistry. Yet their views should never occupy the main place in the presentation of chemistry. He who leads the student into our science by a by path instead of stimulating him to *pure chemical thought*, does in verity make chemistry a 'science of inferior worth'" (Ostwald).

"As Clemens Winkler aptly says, 'physical chemistry in no sense covers the same field as inorganic chemistry, for the latter, far from being a closed branch of science, offers countless problems which must be solved by quite other methods than those furnished by the theory of ions.'"

The quotations indicate the character of the book. It is a masterpiece of descriptive chemistry, a book written for riper German university students. If a translation is made it will doubtless be harmfully introduced into our colleges, possibly into high schools. As there is fortunately no translation as yet, the use of the book will be limited to teachers and older students reading German, and to them it will be a benefit and a pleasure.

As introduction, the author in seventy-five pages discusses weight and measure, heat, theories of gases, Avogadros law, laws of chemical changes, etc. In short, he has brought together what is generally scattered throughout the book. If this were a book for beginners this method would be open to adverse criticism. For older students the reviewer believes it to be the better arrangement, especially when the treatment is as good as here. The author tacitly assumes that the reader is prepared by previous study to follow him without diffuse explanations.

The next division covers the non-metals in 400 pages, the last division the metals in 320 pages. Erdmann divides the non-metals as follows: *Chief gases*, oxygen, hydrogen, nitrogen. *Noble gases*, helium, neon, argon, krypton, zenon. *Air*. *Sulphur group*, sulphur, selenium. *Halogens*, fluorine, chlorine, bromine, iodine. *Phosphorous group*, phosphorous, arsenic, antimony. *Carbon group*, boron, carbon, silicium, germanium.

It is evident from this division that the author does not utilize the periodic system as a means of instruction; indeed he only devotes three pages at the close of the book to the system, his treatment coinciding with that of Ostwald's 'Grundlinien der anorganischen Chemie' in this respect, but in no other. This shelving of the periodic system is to be regretted; it does not accord with the influence which this system exerted and still exerts in the chemical thought and chemical work of the last thirty years and of the present.

At the close of each chapter is a beautifully

illustrated section headed 'Technique and Experiments'; these sections are very pleasing. The apparatus is of the most modern type, many experiments are new.

The author had Professor Ramsay's cooperation in rewriting the chapter on noble gases for this edition. The chapter includes full illustrated descriptions of the methods for obtaining argon and helium, and colored tables of the spectra of all the noble gases, showing the three spectras of argon—the blue, the red and the green. Another interesting chapter is that devoted to flame, illumination, photometry, burners, furnaces, fuel gases, fuels and heat values. In this, as indeed in the whole book, we find the newest methods and the latest statistical results. Striking examples of this are shown in the references to persulphuric acid and to radium; in the first instance the work of Baeyer and Villiger on 'Caro's Reagent' in the *Berichte* of June 7th is utilized for the book which appeared in October; in the latter instance we find in the chapter on barium a brief discussion of radio activity, radium and polonium and of the work of Becquerel, of the Curie's and of Lengyel.

Of more vital importance to the student are the methods of formation of substances and their use in modern technical chemistry, which are not found in any other text-book. For example, recently published books state that hydrochloric acid is obtained technically only as a by-product in the Leblanc process. Erdmann says that while in England one-half million tons of salt are used yearly for Leblanc soda, in other countries this process has only 'historical interest.' Hydrochloric acid, he says, is now made in Germany either as a by-product in the Glauber salt industry from salt and sulphuric acid, or by decomposing magnesium chloride with superheated steam. We find that magnesium chloride is obtained from Strassfurt Carnallite as by-product in crystallizing potassium chloride from Carnallite solution or as a by-product in the manufacture of Glauber salt by action of a solution of Strassfurt Kieserite on salt at low temperatures, 8,000 tons Glauber salt being made yearly by the latter method.

The theoretical side of the book is also well developed. Physical chemical theories are, it is true, but little utilized. The author explains the theory of ions briefly under the head of acids, and refers to this and other theories from time to time throughout the book, devoting seven pages at the end to a condensed discussion of the laws of electro-chemistry and of electrolytic dissociation; that is all. But if we examine Erdmann's treatment of any class of compounds in detail we find that more space is given to the theoretical side—as we have hitherto been accustomed to define 'theory'—than by Ostwald, despite the demand of the latter author that a text-book of chemistry shall devote all its space to 'pure chemistry.'

A comparison is justified by the decided stand both authors take. Both volumes are alike in size of page and type, Ostwald having 795 pages and Erdmann 757. The reviewer has chosen at random the oxygen and hydrogen compounds of nitrogen for the purposes of comparison. Ostwald devotes 36 pages to the subject; about one-half of this space is devoted to physical chemical considerations of great interest; the other half is descriptive chemistry in the narrowest sense, no reference being made to any modern work on structure. Erdmann gives 58 pages, of which 14 are given to illustrated experiment and technique; the remaining 44 pages give fact, theory and statistics; he opens the subject with 5 pages devoted to a study of the constitution of the compounds, relations of the different hydroxyl-acids, etc. Six pages follow on the formation, decomposition and properties of nitric acid, a full but carefully condensed statement. Ostwald gives 1½ pages to nitric acid, namely, composition HNO_3, saltpeter, Chili saltpeter, decomposition of Chili saltpeter by sulphuric acid in two stages, and a few words on the properties of nitric acid. In short, no more than is contained in an average school chemistry. Erdmann gives 4½ pages to hydrazine and hydrazoic acid; Ostwald, 1 page. Erdmann gives 2 to hyponitrous acid, explaining the stereoisomeric forms, which are ignored by Ostwald in the 15 lines given by him.

In a recent review of Ostwald's book it is said, "Every chemist should own a copy of this book and should conscientiously study it."

The present reviewer subscribes heartily to these words and intends no belittling of this brilliant book, but the fact remains that so much space in it has been required for the applications of physical chemical theory, that much of what we have hitherto considered higher inorganic chemistry has been crowded out, theory as well as fact, and that Erdmann's book supplies those facts and those theories which are lacking in Ostwald's. Every chemist should own and study both books.

EDWARD RENOUF.

NOTES.

Copies of the 'Descriptive Catalogue of Government Publications of the United States from September 5, 1774, to March 4, 1881, compiled, by order of Congress, by B. Perley Poore, Clerk of Printing Records, are now for sale for $1.90. Remittance should be by money order payable to W. H. Collins, Chief Clerk, Government Printing Office, Washington, D. C.

THE work on the 'Mammals of Egypt,' left unfinished by the recent death of Dr. John Anderson, will be completed under the supervision of Mrs. Anderson.

UNDER the title 'First on the Antarctic Continent' Mr. Borchgrevink, the commander of the recent Antarctic expedition, has now completed the account of his voyage in the *Southern Cross* and of the adventures and incidents in the land near the South Pole. The volume will be published very shortly by George Newnes (Limited).

PROFESSOR WILBUR C. KNIGHT has published a large-sized block-line geological map of Wyoming in Bulletin 45 of the Wyoming Experiment Station, accompanying 'A Preliminary Report on the Artesian Basins of Wyoming.'

D. K. KEILHACK has issued, through the Gebrüder Borntraeger of Berlin, the fourth yearly edition of his Taschenbuch für Geologen, Palæontologen und Mineralogen.

SOCIETIES AND ACADEMIES.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 109th meeting, held at the Cosmos Club, January 23, 1901, the following papers were presented:

Shell Bluff, Georgia, one of Lyell's Original Localities: T. WAYLAND VAUGHAN.

This locality is in Burke county, Georgia, on the Savannah River, about 20 miles in a straight line below Augusta, and about 100 miles above Savannah. It was examined by Sir Charles Lyell during his first visit to the United States and was first brought into prominence by him. Subsequently Conrad visited and studied the bluff, and considering it paleontologically peculiar, gave the name Shell Bluff Group to the beds there exposed, correlating them with the base of the bluff at Vicksburg, Miss., and placing them in the columnar section immediately beneath the Jackson. Later several other geologists, including Loughridge and Professor W. B. Clark, visited the locality. Because of the prolonged discussion as to the precise position of the Shell Bluff section in the Eocene series, Mr. Vaughan visited the locality during December, 1900, and made a considerable collection of fossils. All the face of the bluff, something over 70 feet, except the uppermost 10 feet, contains a fauna identical in essential species with the Lisbon beds of Alabama, the Wautubbee beds of Mississippi, and the Texan and Louisianan Lower Claiborne of Harris and Vaughan. The uppermost layers contain almost exclusively *Ostrea Georgiana* Conrad, no fossils that could be used as positive stratigraphic indices being found, but it is most probable that this portion of the section also belongs to the same horizon. Compared with the section at Claiborne, Alabama, the section of Shell Bluff can be correlated with the Lisbon, the second horizon beneath the Claiborne sands proper, *i. e.*, it is below the *Ostrea sellonformics* bed which immediately underlies the Claiborne sands.

A few of the species are: *Turbinalia pharetra* Lea, *Endopachys maclurii* (Lea), *Mesalia obruta* (Conrad), *Venericardia planicosta* Lam., *Venericardia alticostata* (Conrad), *Corbula oniscus* Conrad, *Pteropsis lapidosa* (Conrad). Approximately forty species were collected.

Trias in Northeastern Oregon: WALDEMAR LINDGREN.

As a preliminary, the occurrences of marine Trias in the western part of North America

were reviewed. It was shown that a gap existed between the known localities in northern Nevada and California on one hand, and those of British Columbia on the other. This gap has partly been bridged by the discovery of an extensive series of marine Trias in northeastern Oregon. No Trias has previously been found in this State.

The result of a reconnoissance during the past field season has shown that the larger part of the Blue Mountains of Oregon are made up of older rocks of probably Carboniferous age. In the Eagle Creek Mountains, however, which form a circular mountain group in the extreme northeastern corner of Oregon, surrounded on nearly all sides by Columbia River lava, the marine Trias was found very strongly developed, although the fossils thus far obtained do not afford paleontological subdivisions. The fossils, though scant, unquestionably indicate a Triassic age. They consist, besides pentacrinus stems and fragments of echinoids and ammonites, of various specifically indeterminable Halobias and Danonellas. The series consists of a great thickness, probably several thousand feet of shales and limestones. Associated and interbedded with these are vast masses of tuffs and various old lavas. The limestone is very prominently developed and its weathering gives rise to peaks and cliffs of Alpine character.

The same series was found well represented in the Snake River canyon on the boundary of Idaho and Oregon. Here, however, the volcanic material predominates, the sedimentary rocks appearing as intercalated masses. Halobias were again found in this series. It appears that these Triassic rocks continue with a northeasterly strike into Idaho across the Seven Devils and the lower Salmon River Canyon, until at some point in the vicinity of the Clear Water River, they give place to intrusive granites and older schists.

A Comparison of the Ouachita and Arbuckle Mountain Sections, Indian Territory: J. A. TAFF.

The Ouchita mountain range extends from the vicinity of Little Rock, Arkansas, to the Missouri, Kansas and. Texas Railway, near Atoka, in Indian Territory. The hard sandstone and novaculite formations make ridges rising from 1,000 feet at the end of the range, to nearly 2,000 feet in the central part. The high ridges have strikingly level crests which probably represent a Cretaceous plain. The softer rocks are generally worn down to heights between 600 and 1,000 feet above the sea.

The Arbuckle range, with the exception of a central igneous peak, contrasts strongly with the Ouachita range in physiographic aspects. It is strictly a plateau, only partially dissected and but little below the original Cretaceous base level. It rises gradually to about 1,350 feet on the west, from the Cretaceous contact having an average elevation of 750 feet, on the east and southeast. The gap between the Ouachita and Arbuckle uplifts is about 20 miles wide and is occupied by slightly disturbed coal measures and Cretaceous rocks.

The lowest rocks in the section of the Ouachita range are Lower Silurian sediments in the heart of the uplift near the Tertiary border southwest of Little Rock. Above these are the Lower Silurian novaculites, 1,200 feet thick, which were the highest Silurian strata recognized by L. S. Griswold, of the Arkansas Geological Survey. In Indian Territory above the novaculites are about 5,000 feet of shale. These are in turn succeeded by about 5,000 feet of sandstone. Above these sandstones comes limestone of Ordovician age. Lower Helderberg cherts and limestone, Mississippian shales and coal measures, complete the section above the Ordovician.

The section of the rocks in the Arbuckle mountain uplift from the Lower Helderberg upward is a repetition of the Ouachita mountain section upward from the same terrane, but is not nearly so thick. Below the lower Helderberg is a mass of Ordovician limestone with shale and sandstone of minor importance, reaching a total thickness of more than 6,500 feet. These cannot be compared lithologically with the known Ordovician in the Ouachita mountain uplift. The limestones rest uncomformably upon a mass of older granites with a variable intervening bed of arkose and conglomerate.

The structure of the Ouachita range is typically Appalachian. The rocks for the most part have been sharply folded and very extensively overthrust. The structure of the eastern

half of the Arbuckle uplift consists of relatively wide shallow folds. The axial portions of the synclines have been dropped down by opposite normal faults. In some instances the vertical displacements amount to many thousand feet. The softer and thinner formations, from the upper Ordovician to the coal measures, which occupy the downthrown blocks, were crumpled into narrow folds prior to the faulting.

F. L. Ransome,
David White,
Secretaries.

SECTION OF BIOLOGY OF THE NEW YORK ACADEMY OF SCIENCES.

The regular monthly meeting for January was held on the 14th, Professor C. L. Bristol presiding. Dr. H. E. Crampton was elected Secretary, in place of Professor F. E. Lloyd, resigned.

The following program was offered:

(1) 'A New Species of *Phoronis*': H. B. Torrey.

(2) 'Characters and Relationships of the Belodont Reptiles': J. H. McGregor.

(3) 'Notes on *Chrysoma pauciflosculosa*'; 'On the Occurrence of Nectaries in *Pteris aquilina*': F. E. Lloyd.

Mr. Torrey described a new species of *Phoronis*, the first that has been collected upon the western coast of America. It is intermediate in its characters between the European and eastern American species, and those found in Australia and the Philippines. In size it agrees with *P. Buskii*. The lophophore, though spirally coiled—thus differing from that of the European species—is less complex than that of *P. Buskii*, and the tentacles are fewer in number (200). The longitudinal muscles are stouter than those of *P. Buskii*, agreeing more nearly with the condition in *P. architecta* of the east coast. The new species agrees with this latter species in habit, in the possession of a longitudinal ciliated ridge in the digestive tract, and in the possible separation of the sexes.

Dr. McGregor presented the results of a recent study of the Belodonts, a group of fossil reptiles occurring in the Triassic of Germany and North America. The Belodonts have usually been regarded as ancestral crocodiles, though many students of the group have admitted possible affinities with Rhynchocephalia and Dinosauria. The material used in the present study, chiefly from the genera *Mystriosuchus* and *Rhytinodon*, yielded some parts new to science, *e. g.*, the atlas and clavicle. The presence of two cervical intercentra and a large clavicle tends to ally the group more closely to the Rhynchocephalia. The hyoid apparatus was found to be suspended from the skull as in Hatteria; and there is strong evidence that the carpals (and probably also the tarsals) remained cartilaginous throughout life. Some doubt was expressed regarding the Belodont ancestry of the crocodiles, though it was admitted that the Belodonts stand near the crocodilian stem. The suggestion was made that the Belodonts may belong on or very close to the line of descent of the Ichthyosauria, occupying a position midway between some Permian land-living Rhynchocephalian and the marine Ichthyosauria of the Jurassic. In support of this theory, many structures of the Belodonts were shown to be such as one would expect to find in an ancestor of the Ichthyosauria, *e. g.*, position of the nares, elongated premaxillary, bicipital ribs, form of the shoulder-girdle, etc. Some other structures, apparently incompatible with this view, were shown to be in reality not inconsistent with it.

In a discussion of Dr. McGregor's paper, Professor Osborn emphasized the importance of the Belodonts, and the conflicting nature of the opinions regarding them. Huxley placed them near the crocodiles, as evidenced by the choice of the name *Parasuchia* for the group. The paleontologists of the Stuttgart school relate them to Dinosauria. Dr. McGregor is the first to bring out the idea of their relationship to the Ichthyosauria; and, based as it is upon many new characters described for the first time, the theory is of great interest and importance.

Professor Lloyd stated that the chief point of interest in *Chrysoma pauciflosculosa*, a sub tropical marine form, is in the structure of the leaves. The surface of these is sculptured in the form of a mosaic. This appearance is caused by deep and regularly-arranged involutions of the epidermis. At the bottom of each sulcus are to be found flagellated and glandular hairs, such as have been described by Vesque for

the Compositæ. Transverse sections show that each element of the mosaic contains chlorenchyma, which, though packed densely around the edges, forms in the middle a large air-chamber, suggesting in appearance the air-chambers of certain Hepaticæ. The leaf, a bifacial one, is maintained in a vertical position.

In a second paper, Professor Lloyd drew attention to the occurrence, in *Pteris aquilina*, of nectaries near the bases of the pinnæ. The activity of these glands reaches a maximum during the development of the frond in spring and early summer, at which time large drops of syrupy nectar exude from the openings, which are modified stomata. The object of the speaker was to call the attention of teachers of general biology to the presence, in a much-used laboratory type, of organs which, though discovered by Francis Darwin in 1877, were generally overlooked.

In discussion of Professor Lloyd's first paper, Professor Britton remarked that the author's results were of value as throwing light upon the vexed question of the relationship of *Chrysoma* to the golden-rods (*Solidago*). The two groups were probably distinct. It was also recalled that the late Dr. Gregory had worked extensively upon this problem, but her full results had never been published.

HENRY E. CRAMPTON,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis of January 21, 1901, twenty-seven persons present, the following subjects were presented:

Rev. M. S. Brennan read a short sketch of the progress of astronomy in the United States, in which the material equipment and the discoveries made in that science in this country during the past century were passed in review.

A paper by Professor T. G. Poats, entitled 'Isogonic Projection,' was presented in abstract.

Professor F. E. Nipher showed by means of the lantern a series of negatives printed by contact from a lantern slide or positive picture, by the light of a 300 candle incandescent lamp. The unit of exposure adopted was one lamp-meter-second. The exposures varied from 0.0054 to 4,800. All were developed in the dark room with hydrochinon, those above 0.1 exposure having in the bath one drop of saturated hypo to the ounce of bath. The plate having an exposure of 0.1 seemed to be normally exposed. An exposure 210 gave a negative showing some fogging, but a print from it by ordinary methods gave a very satisfactory result. With longer exposures, the plate began to reverse, locally. With an exposure of 3,600, which was an exposure of one hour at a distance of one meter from a 300-candle lamp, half of the plate still showed as a negative. The shadow on the gown of a figure in the landscape showed white as a negative, and the part of the gown in sunshine showed white as a positive. The penumbra between light and shadow was darker. All the details were sharp, but lights and shadows were somewhat incongruous. With an exposure of 4,800 the details had not yet all reversed, but the greater part of the plate had become a positive.

The greatest exposure giving a negative which would yield an acceptable print was 210, which was 39,000 times the least exposure which would give a good negative. All exposures of 210 and over gave complete positives when the plates were developed 1.41 meter from a 16-candle lamp, or in stronger light. As good a picture as has been obtained had an exposure of 4,800, and was developed within half a meter of a 300-candle lamp. A fair picture had even been obtained from a two-hour exposure to direct sunlight with a Cramer 'Crown' plate. This plate was developed in a perfectly dark room.

It was stated that hypo in the developing bath did not affect the zero condition, or change the character as regards positive and negative. When no hypo is used, the plate fogs so quickly that the picture is invisible, before it has time to fully develop. After fixing, the thin shadowy picture showing on the fogged plate has the same local positive and negative characters that are shown on the clearly defined picture of the same exposure, when developed in the hypo-hydrochinon bath.

The greatest exposures giving good results that have been measured with reasonable accuracy were about 900,000 times as great as the

least exposure giving a good negative in the dark-room. This factor can certainly be trebled. A plate having any intermediate exposure can be developed either as a good positive in the light, or as a good negative in the dark-room.

It was stated that the best results with plates near the zero condition had been reached with a rather strong bath, with two drops of saturated hypo to the ounce of bath.

Three persons were elected to active membership.

WILLIAM TRELEASE,
Recording Secretary.

SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

THE January meeting of the Club was held on the evening of the 24th inst., President Birge in the chair. Professor J. M. Coulter, of the University of Chicago, delivered his address on 'The Teaching of Science' (substantially as published in this JOURNAL, Vol. XII., p. 281). At the close the president related an incident from his own early experience to show how completely scientific education was misunderstood by the classicists, and he expressed the opinion that the quality of science teaching in the universities is not so poor as Professor Coulter would have us believe. The president extended the very evident thanks of the audience to the speaker for his address.

E. R. MAURER,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE SIDGWICK MEMORIAL.

TO THE EDITOR OF SCIENCE: I have been asked to act in America for the English committee on a memorial to the late Professor Henry Sidgwick. Other Americans are probably acting also, but of this I do not know. A meeting in the interests of such a memorial was recently held at Cambridge, and an influential committee was appointed. The memorial will probably take the form of an endowed scholarship at Cambridge, though other projects are also before the committee. Seeing the services Sidgwick rendered to education—notably woman's education—and the very large use made of his books in American universities, it is hoped that a considerable sum will be raised in this country. Contributions, to be forwarded through me, may be sent direct to Princeton, New Jersey.

J. MARK BALDWIN.

SHORTER ARTICLES.

RADIO-ACTIVE MINERALS.

IN searching for radio-active substances with one of Professor Rood's new electrometers, an instrument particularly well adapted to the purpose, several minerals not hitherto noted were found to be radio-active. Professor Rood suggested that I should try columbite, and gave me some specimens. The electrometer immediately shows that the air in the neighborhood of the mineral is ionized, and later photographic tests confirm the radio-activity of columbite. A chemical analysis of the specimens has not yet been made, but according to Dana, columbite does not contain uranium or thorium.

Specimens of erbium oxide and niobium oxide, from the museum of the chemical department, also show with the electrometer a slight ionizing effect. Further investigations are being made.

GEO. B. PEGRAM.

PHYSICAL LABORATORY OF COLUMBIA UNIVERSITY, January 26, 1901.

THE MUSICAL BOW IN CALIFORNIA.

IN view of the present discussion in regard to the existence of the musical bow in America, and of its independent development on this continent, the occurrence (quite rare at present, however,) of a form of this instrument among the Maidu Indians of Northern California appears worthy of a brief note.

The bow as used by the Maidu is a simple bow of cedar, some 2½ feet in length, at present strung with wire, but formerly with a fine sinew cord. In playing the instrument it is held in the left hand (the hand grasping the center of the bow, thumb inside and palm facing forward), the bow extending horizontally to the left. The right-hand end of the bow is placed in the open mouth, and the bow string tapped rapidly with a small flexible twig held in the right hand. By varying the size of the resonance chamber (the mouth) with the aid of the tongue, and by opening or closing the mouth to a greater or

less extent, notes are produced as in a Jew's harp. The tones are, however, very faint, and are audible only at a short distance.

The use of this bow, known as 'kāwotōne panda,' is restricted to the medicine-men or shamans, and other persons are rarely allowed to see and never allowed to touch the instrument. The sacredness of this bow, the fact that it is used by the medicine-men only in communicating with and praying to the 'kukini' or spirits, and that its manufacture is accompanied by ceremonial observances, including the rubbing of the bow with human blood—all seem to point to the bow as being of native origin. The limited contact of these Indians with the negro, and the place held by the instrument in the religious life of the people, here as well as elsewhere in America, would seem to militate against the view that the musical bow is on this continent the result of acculturation.

ROLAND B. DIXON.

CURRENT NOTES ON PHYSIOGRAPHY.

THE YOSEMITE VALLEY.

A CAREFUL study of 'the Pleistocene Geology of the south central Sierra Nevada with especial reference to the origin of the Yosemite valley,' by H. W. Turner (*Proc. Cal. Acad. Sci.*, 3d ser., Geology, i, 1900, 261–321, 8 pl.) is of much interest, but still leaves this interesting problem without definite solution. The suggestion that the valley is a *graben* is discarded, yet direct proof or disproof of this view can be gained only when identifiable structures are found in the rocks of the valley floor and of the uplands, as has been done in the case of the Rhine *graben*. It is concluded that 'the canyons of the Sierra Nevada, like most other canyons the world over, were formed in the main by river erosion'; but it is suggested that after a rather extended glaciation of the Sierra highlands, narrow and deep canyons were cut in an interglacial epoch, and that ice streams of a second glacial epoch 'greatly modified the new-cut canyons of the interglacial epoch, and gave them, within the glaciated area, substantially their present form.' The contrast between the broad U-shaped section of the Yosemite and the sharp V-shape of the Merced canyon farther west seems to favor this view. Moraines are found on the valley floor at six points, the westernmost being where the open valley ends and the V-canyon of the Merced begins; it is pointed out that the size of the moraines would be greater if their bases were not generally buried in river sands and silts.

Gannett, commenting on Turner's article, forcibly maintains the glacial origin of the Yosemite, appealing especially to its hanging lateral valleys in support of his opinion (*Geogr. Mag.*, XII., 1901, 86–87).

PATAGONIA.

THE geographical results of the Princeton expeditions to Patagonia are presented by Hatcher in most interesting form. ('Some geographic features of southern Patagonia, with a discussion of their origin,' *Nat. Geogr. Mag.*, xi, 1900, 41–55.) The eastern coast shows a line of sea cliffs, from 300 to 500 feet high, seldom broken except at river mouths where the few harbors are found. The strata in the cliffs are nearly horizontal, but by following them for long distances two marine formations separated by a continental formation are discovered, all being covered by 20 or 30 feet of unstratified boulders and clays, the great shingle formation, of glacial and aqueous origin. Vast plains stretch inland from the coast, subarid, bearing thin grass and scattered bushes; guanacos and rheas are found here in abundance. The plains are broken by escarpments, often several hundred feet high, trending north and south, and interpreted as sea cliffs formed during the latest emergence of the region. Recent lavas cover considerable areas in the central interior, forming scoriaceous plains of large extent, here and there dissected by canyons. Indeed, all these features are broken by the valleys of rivers coming from the back country. One of these valleys, that of San Julian, has at present no stream; its waters having been captured by a northern tributary of the Santa Cruz, 100 miles in from the coast. Numerous depressions holding small salt lakes are interpreted as remnants of an ancient valley system, now masked by deposits formed during the last submergence of the region. The district piedmont to the Andes is sheeted with morainic

drift, the most fertile part of the plains; water is here plenty in small lakes. The peculiar drainage system of the Andean region is explained chiefly by the Pliocene depression and elevation of a previously dissected mountain range. Glacial erosion is not especially considered as contributing to the present topography. W. M. Davis.

ZOOLOGICAL NOTES.

During the past year, L. Camerano has published (in *Atti della R. Accademia delle Scienze di Torino*, Vol. XXXV., and *Arch. Ital. de Biol*, Vol. XXXIII., fasc. 2) papers on the 'somatic coefficient.' These are based on a plea made by Andres that ichthyologists and others express the proportion of parts of the body not in relation to any other convenient organ, as is often done, but rather in thousandths of the total body length. Thus, if x is the proportion to be expressed, l is the observed dimension, and L is the total length of the body, in millimeters, then, $x = \frac{1{,}000}{L} l$. The factor $\frac{10{,}000}{L}$ is the somatic coefficient and is constant for all organs of the body. Camerano makes the suggestion that the number 360, being readily divisible by more integers, is preferable to 1,000 and he publishes a convenient table of values of $\frac{360}{L}$ for every quarter unit from 1 to 360. It is to be hoped, however, that those who express the dimension of organs in multiples of the somatic coefficient will not fail to give also the absolute lengths of the organs, as these are of no less importance. C. B. D.

In describing to the Zoological Society of London, on January 15th, the collection of fishes brought home from Lakes Tanganyika and Kivu by the Tanganyika exploring expedition, under the leadership of Mr. J. E. S. Moore, Mr. G. A. Boulenger pointed out that the study of this important collection did not modify the conclusions embodied in his first report published in 1898. The exploration of Lake Kivu had thrown no light on the origin of the Tanganyikan fauna; the smaller lake proved to be very thinly populated with fishes, which all belonged to widely distributed genera, the species showing a mixture of Nile and Tanganyika elements, with two that might prove to be endemic. The list of the fishes from the two lakes comprised 91 species, 74 of which had been named by the author. The collection now described consisted of examples of 50 species, 26 of which were new to science, 2 being made the types of additional genera of the family *Cichlidæ*.

A BILL ESTABLISHING A NATIONAL OBSERVATORY.

We are now able to publish the text of the bill introduced into the Senate by Mr. Morgan on January 21st. The provisions seem to be all that could be asked, and it is to be hoped that men of science will unite in urging its passage. Personal letters to members of Congress and resolutions adopted by societies and institutions and forwarded to the Committee on Naval Affairs are the most effective way to advocate the measure. The bill is intended 'to organize the National Observatory of the United States' and reads as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the United States Naval Observatory shall hereafter be known as the National Observatory of the United States, and shall be governed by a Director thereof, who shall report directly to, and be under the supervision of, the Secretary of the Navy.

Section 2, That the Director of the National Observatory shall be an eminent astronomer, appointed by the President, by and with the advice and consent of the Senate, at a salary of five thousand dollars per annum, and shall be selected from the astronomers of the National Academy of Sciences unless, in the judgment of the President, an American astronomer of higher scientific and executive qualifications shall be found.

Section 3, That the Secretary of the Navy may detail for duty as astronomers at the National Observatory such professors of mathematics and other officers of the Navy as he shall deem necessary in the interests of the public service; but on and after the

passage of this Act no appointments shall be made of such professors unless required for service at the Naval Academy.

SECTION 4, That there shall be a Board of Visitors of the National Observatory, to consist of one Senator, one member of the House of Representatives, and three astronomers of eminence, to be selected by the Secretary of the Navy. The Board of Visitors shall make an annual visitation, or more frequent visitations, of the Observatory, advise with the Director thereof as to the scientific work to be prosecuted, and report to the Secretary of the Navy on the work and needs of the Observatory on or before the first day of November in each year. The members of the said Board may receive an allowance not exceeding ten dollars per day each during their actual presence in the City of Washington while engaged on the duty of the Board and their necessary traveling expenses; but no officer of the Government appointed on the Board shall receive any additional compensation for such duty above his actual expenses.

THE REORGANIZATION OF THE DEPARTMENT OF AGRICULTURE.

THE Agricultural Appropriation Bill, as presented to the Committee of the Whole of the House of Representatives, contained provisions for the reorganization of the Department of Agriculture, which we much regret were afterwards withdrawn, owing to the point of order being raised that new legislation had been attached to an appropriation bill. It is well-known that the salaries in the Department are too small, and that the Government is constantly losing the services of its trained scientific men. Thus Dr. Loew received a salary of $1,800 in the Department of Agriculture, and has now accepted a position under the Japanese Government at a salary of $7,000. The plan proposed by the Committee on Agriculture would have created four new bureaus, the chiefs of which would have received a salary of $3,500 a year, and who would have been the chiefs of divisions who now receive $2,500 a year, and the salaries of the other scientific experts would have been increased by sums varying from $200 to $500 each. The total increase in salaries would have been $26,000. In recommending this plan the Secretary of Agriculture, the Hon. James Wilson, wrote to the Chairman of the Committee on Agriculture, the Hon. J. W. Wadsworth, on January 15th, as follows:

Having gone over with care the proposed plan for the reorganization of the Department of Agriculture, I am pleased to state that it has my entire approval. The grouping together of scientists in kindred lines of work will enable us to bring to bear on each subject considered and on each undertaking before it is begun the experience of all the division chiefs interested, avoiding duplication of work, which quite frequently occurs under our present divisional system, and in that regard will enable us to economize.

The salaries as proposed are not in excess of what is paid to scientists doing like work in educational and experiment station institutions throughout the country, and are, in fact, much below the salaries paid by many institutions in the land that seek men of the greatest experience and highest attainments. The work now being carried on by this Department and the amount of money being expended by Congress justify the employment of the foremost scientists in every line.

We are not able to retain our best men at the present time. Other countries, as well as home institutions, take them away from us by offering more money than our statutory salaries. If it were possible for this Department to go to the country, through the Civil Service Commission, and get scientists well informed regarding the work we are doing for the farmers, the loss of a man now and again would not be so serious.

But this Department is compelled, in many of its divisions, to educate its own men. When they leave us, on account of getting better pay elsewhere, our work in some cases stops until new men can be trained.

I therefore sincerely hope that you will succeed in having the proposed rearrangement enacted into law. It will do much to facilitate our work, and I believe will in the end be economical.

It is to be hoped that the reorganization of the Department, approved by the Secretary of Agriculture and the House Committee on Agriculture, will be introduced as a special bill. Scientific men at Washington can not well advocate a measure that increases their salaries, and there is consequently every reason for those interested in science and not connected with the Government service to use all efforts to secure the introduction and passage of a measure that is essential for efficiency and economy.

SCIENTIFIC NOTES AND NEWS.

At a meeting of the Prussian Academy of Sciences, held on January 24th, the announcement was made that the Helmholtz Medal had been conferred upon Sir George Gabriel Stokes, of Cambridge University. The medal has hitherto been conferred only on Professor Virchow and Lord Kelvin.

At a meeting of the Council of the Astronomical and Astrophysical Society of America, held in New York, on January 29th, at which all members of the Council save one were present, the previous action by which Denver was designated as the next place of meeting for the Society was reconsidered, and by unanimous vote the Council determined to hold no meeting during the summer of 1901. In lieu of the customary summer meeting of the Society, a winter meeting will be held in the City of Washington during the next Christmas holidays, and Professors Newcomb and Brown were appointed a local committee to arrange the details of such meeting. The Committee upon Legislation affecting astronomical interests made through its chairman a report of progress, and was continued. Professor W. W. Campbell, director of the Lick Observatory, was elected a member of the Council in place of the late Professor James E. Keeler.

Professor R. W. Wood, of the University of Wisconsin, has decided not to accept the invitation of the director of the U. S. Naval Ob servatory to go to Sumatra as a member of the eclipse expedition, but he has fitted up a polarizing spectroscope to test the method, recently described by him in Science, of photographing the Fraunhofer lines in the spectrum of the corona, by placing a Nicol prism in front of the slit of the instrument in such a position as to transmit the polarized light reflected by the coronal particles. Dr. Norman E. Gilbert, of the Johns Hopkins University, will operate the instrument, the observations being both visual and photographic. The visual work will be confined to the few moments at second and third contact, when the flash spectrum is seen.

The Reale Accademia dei Lincei of Rome has elected to membership the Duke of the Abruzzi.

Dr. M. Cantor, honorary professor of mathematics in the University of Heidelberg, has been elected a corresponding member of the St. Petersburg Academy of Sciences.

Mr. Evelyn B. Baldwin returned to New York on February 3rd, after having arranged, while abroad, for two vessels for his North Polar Expedition.

Professor Francis E. Lloyd, of Teachers College, Columbia University, has gone abroad on a leave of absence, and will spend the next eight months at Bonn.

Dr. William R. Brooks, director of the Smith Observatory and professor of astronomy in Hobart College, Geneva, N. Y., recently delivered two illustrated lectures in the opera house of that city on 'The Wonders of the Sun and the late Eclipse.' The stereopticon views included a large number of photographs of the eclipse in its partial phases, made at the Smith Observatory, and others taken at different points along the total belt.

A bronze bas-relief of the late Professor M. S. Newberry, the eminent geologist, has been presented to Columbia University by his children.

A bust of Dr. Horace Green, who died in 1866, was presented to the New York Academy of Medicine on February 8th by Mrs. Green and George Walton Green. Dr. D. B. St. John Roosa made a commemorative address.

Miles Rock, whose death in Guatemala was noted in Science of February 8th, was from 1883 to 1898 chief engineer and president of the Guatemala Commission to locate the

boundary between that country and Mexico. His services to Guatemala were so important that he was given an imposing public funeral at the expense of the government, the ceremonies taking place at the National School of Engineers and being attended by President Cabrera and his cabinet.

PROFESSOR MAX VON PETTENKOFER, of the University of Munich, the eminent authority on hygiene and bacteriology, has committed suicide at Munich. He was eighty-three years of age.

MR. R. D. LACOE, well known among geologists and paleontologists for his great aid in the advancement of the sciences of paleobotany and pale-entomology, died at his home in West Pittston, Pa., on the fifth of February.

PROFESSOR JOHN POTTER MARSHALL, until his retirement in 1899, professor of geology and mineralogy in Tufts College, died at his home at Tufts College on February 4th in his seventy-seventh year. He graduated from Yale College in 1844 and was one of the founders of Tufts College, where at first he had charge of all the scientific work, including mathematics, and where he held a professorship continuously for forty-five years.

PROFESSOR EDWARD ELBRIDGE SALISBURY, for sixty years professor of Arabic and Sanscrit at Yale University, died at New Haven on February 5th.

DR. WALTER MYERS, a member of the expedition of the Liverpool School of Tropical Medicine to Brazil, has died from yellow fever while engaged in investigating the disease. Dr. Myers was a graduate of the University of Cambridge and was only twenty-nine years of age.

THE death is announced in his seventieth year of Dr. Bernhardt Danckelmann, for the last 35 years director of the Prussian Royal Academy of Forestry at Eberswalde. He was one of the first to advocate the training of foresters in special colleges, and was the author of important works on forestry.

THE London *Times* announces the death, at Bois de Colombes at the age of 74, of M. Gramme, the eminent Belgian electrician. Brought up as a carpenter, he attended scientific lectures at Liège, where he showed a talent for machinery, and then went to Paris to a manufactory of light house electric lamps. He next worked under Ruhmkorff and Disderi. In 1867 and 1872 he patented electric batteries and the dynamo. For the latter he received 20,000 f. from the French Government and the Volta prize of 20,000 f. from the Academy of Sciences.

THE will of the late Charles F. Emerson gives $100,000 to the town of Castine, Maine, for a library.

WE learn from the *Electrical World* that the private electro-chemical laboratory of Mr. C. P. Steinmetz has been destroyed by fire, which probably had its origin in a coal stove. A considerable part of the apparatus was saved, but a number of interesting investigations being carried out in the laboratory are indefinitely delayed.

THE National Academy of Sciences has made a grant of $500 to the University of California from the Draper fund for the promotion of scientific research, the money to be used in the construction of a first-class one-prism spectrograph for the Lick Observatory.

LORD RANFURLY, Governor of New Zealand, has secured a fine collection of birds for the British Museum, including the *Merganser Australis*, which is almost extinct, and specimens of two species new to science.

THE collection of birds and mammals formed by the late Geo. A. Boardman, of Calais, Me., will be removed to Fredericton, N. B., and will occupy a conspicuous place in one of the Government buildings.

UNIVERSITY AND EDUCATIONAL NEWS.

MESSRS. WILLIAM KEYSER, William Wyman and Francis W. Jenks have offered to give the Johns Hopkins University a new site, on condition that $1,000,000 be collected for the University. The proposed site is some hundred and seventy acres in extent, and is valued at $750,000. It is in the northern part of the city of Baltimore and is well adapted for the purposes of the University.

IT will be remembered that at the recent election an amendment to the constitution of the State of California was adopted, permitting the

Legislature to exempt portions of the property of Leland Stanford Junior University from taxation. A bill has now been passed to the third reading in the Assembly by a vote of 47 to 15, exempting from taxation the real estate occupied by the University and bonds held by it.

THE higher court has sustained the decision upholding the validity of the will of Colonel Joseph M. Bennett which, it will be remembered, left a large estate to the University of Pennsylvania.

BY the will of Daniel A. Buckley, late publisher of the Cambridge (Mass.) *News*, an estate, valued at between $50,000 and $60,000, is bequeathed to the city of Cambridge to be used for the education at Harvard of such graduates of non-sectarian schools as a committee may deem worthy.

IT appears that the school fund of the State of Minnesota has been increased by the discovery of iron ore. Ten million tons have been sold in position for $2,500,000, and it is said that at least 50,000,000 tons can be disposed of in the same way. The State school fund now amounts to $12,500,000, invested in bonds and securities, and the school and university lands are valued at more than $20,000,000.

THE Rensselaer Polytechnic Institute at Troy, N. Y., has in operation a new electrical laboratory containing sixteen machines, generators and transformers, together with a full equipment for practical tests. The laboratory for the testing of materials of engineering has been increased by the addition of one 300,000 pound testing machine and one 100,000 pound testing machine; and a 10,000 pound wire testing machine. There is also a new cement testing laboratory fully equipped for the most approved modern tests.

THE ladies of the Temple Emanu-El in San Francisco, one of the largest Jewish congregations on the Pacific Coast, have founded two graduate fellowships in Semitic languages in the University of California. They have pledged themselves to pay to the University in cash, within two years, the full amount of the endowment, $15,000. Some years ago the ladies of the congregation presented to the university a Semitic library of over three thousand volumes. Jacob Voorsanger, D.D., rabbi of the Temple Emanu-El, has for some years served without remuneration as professor of Semitic languages and literature in the university.

LORD GEORGE HAMILTON has refused to grant the inquiry asked for by the dismissed members of the teaching staff at the Royal Indian Engineering College at Coopers Hill, but it is understood that leading English scientific men will continue the agitation for such an inquiry.

JOHN HUDSON PECK has resigned the presidency of the Rensselaer Polytechnic Institute, and a committee of the Board of Trustees is considering a successor.

DR. FRED. C. ZAPFFE has been appointed professor of histology in the medical school of the University of Illinois.

DR. WALTER T. KRETZ has been appointed lecturer in astronomy in Columbia University.

W. SMYTHE JOHNSON, Ph.D. (Yale), has been appointed to the chair of psychology in the State Normal School at Natchitoches, and Dr. Matataro Matsumoto, assistant in the psychological laboratory of Yale University, has been appointed professor of psychology in the Imperial Normal School of Tokyo, Japan.

MR. P. V. BEVAN has been appointed an assistant demonstrator in physics at Cambridge University, and Mr. H. A. Wilson, has been elected to the Clerk Maxwell studentship in experimental physics.

MR. W. H. WILLCOX, M.B., B.Sc. (Lond.), has been elected to the post of lecturer on chemistry and physics at St. Mary's Hospital Medical School, London.

DR. G. C. SCHMIDT, of Eberswalde, has been elected to an associate professorship of theoretical physics in the Univerity of Erlangen. Dr. H. Boruttan, docent in the University of Göttingen, has been promoted to a professorship of physiology. Dr. Heyn, o the Mechanical Institute of Berlin, has been appointed professor of engineering in the Technical Institute at Stuttgart. At the same institution Dr. Englisch has qualified as docent in scientific photography. Dr. Max Reess, professor of botany in the University of Erlangen, has retired.